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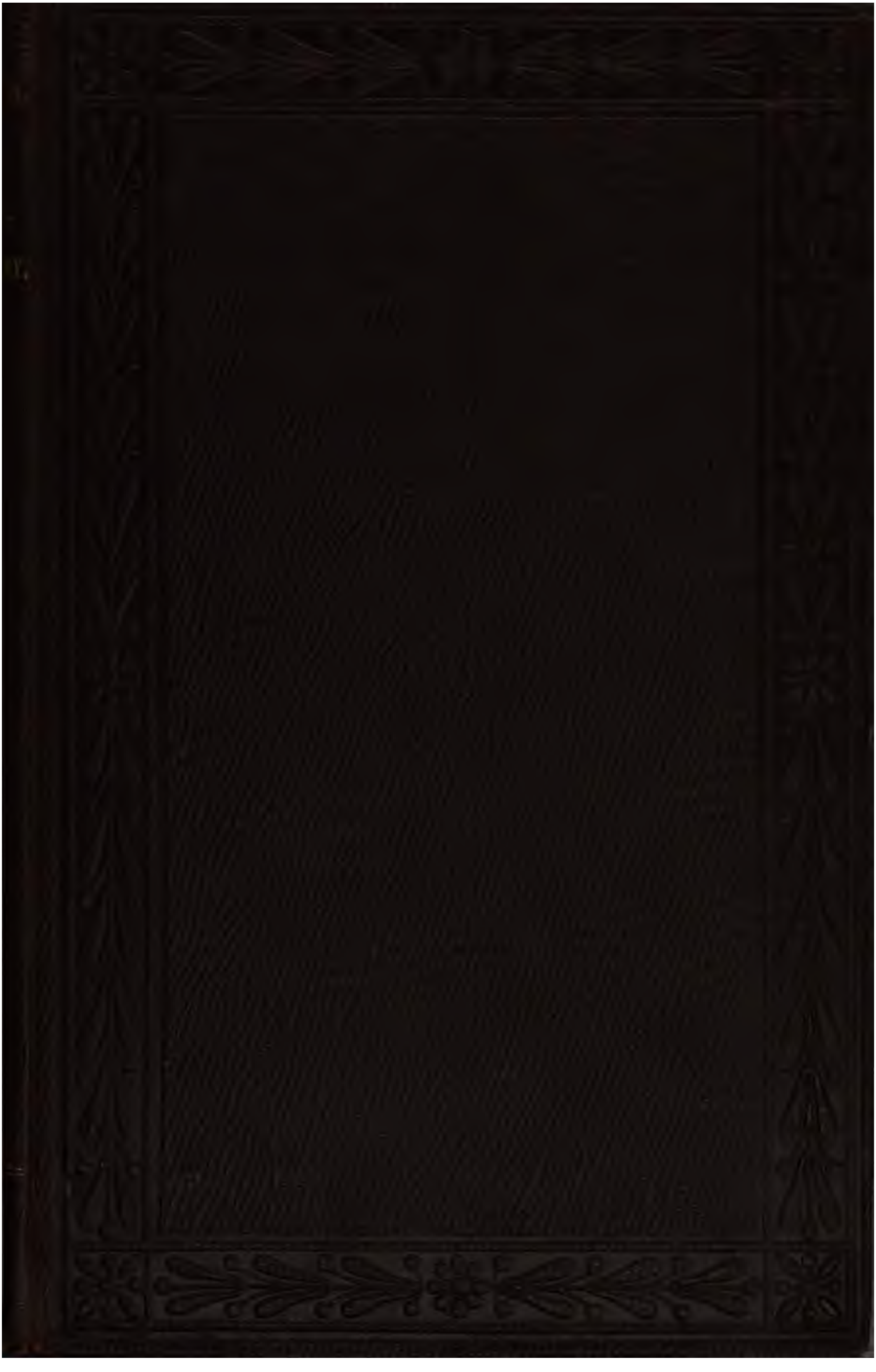

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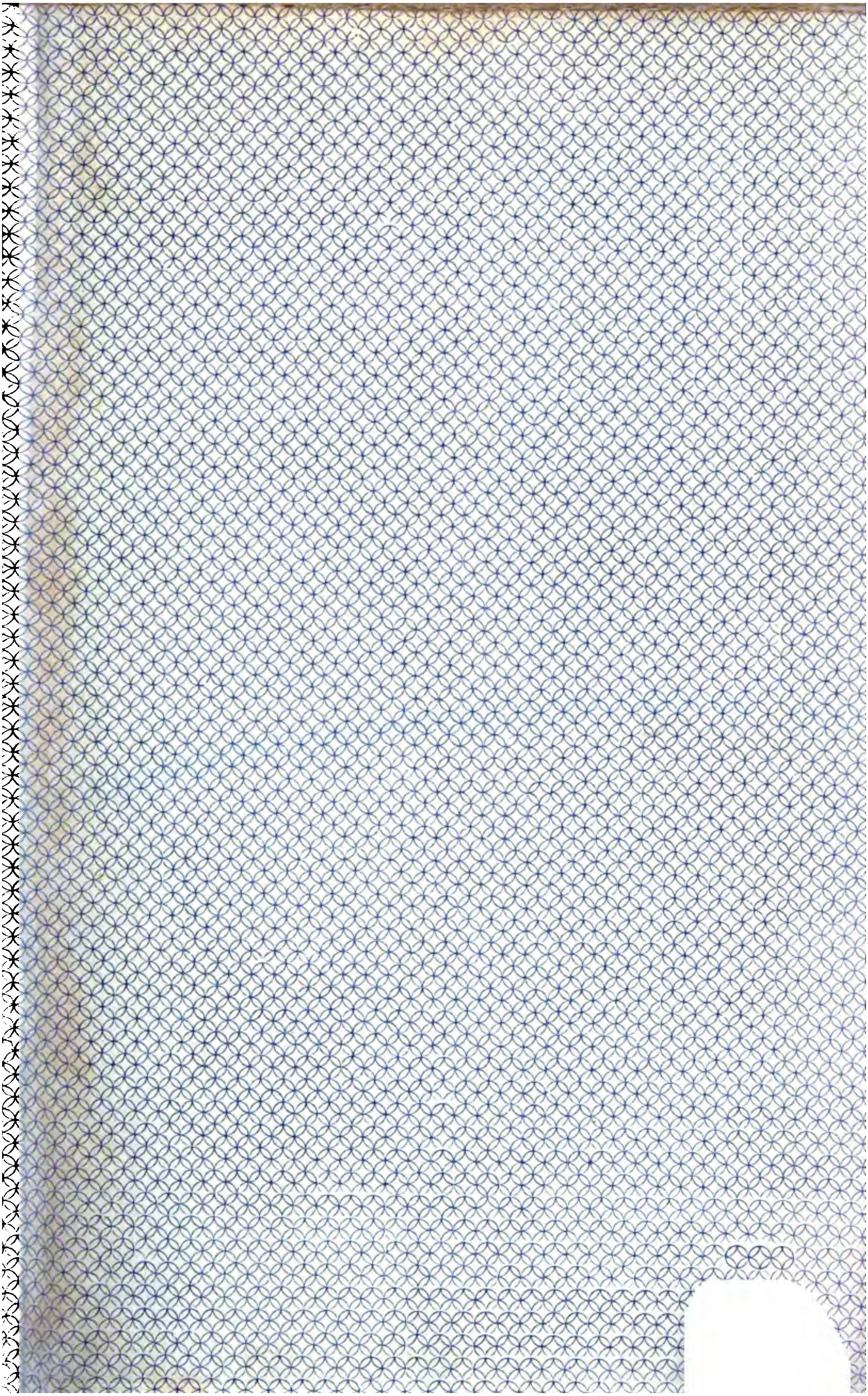

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PREFACE.

The Author of the following Discourses has been occasionally called upon, in his capacity of member of several Literary and Philosophical Societies, and sometimes merely in that of a well-wisher, to contribute to their Transactions. When, in the course of some quarter of a century, these contributions had accumulated to a goodly pile, it occurred to him, on looking them over, that a selection from them would be well received by his friends, and might possibly be acceptable to a wider circle. The Discourses were written at considerable intervals, not with any view to publication, but simply for the occasions on which they were read, and on subjects that happened at the time to interest the writer's mind. After they had served the purpose for which they had been produced, they were laid aside, and their contents almost forgotten. Having been composed, nevertheless, with a good deal of pains at first, and having subsequently undergone a minute revision, they have had, on the whole, as much care bestowed upon them as if they had been originally intended for the press. Without such attentive preparation they would not have been sent forth. It may be added that none of them have before appeared in print.

To two or three of the Discourses, where any elucidation of the circumstances attending the composition, or any additional matter, appeared to be appropriate, the author has appended supplementary notes in preference to loading the Preface with explanations, which would be unintelligible till the subject of them was before the Reader.

January 10. 1852.

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DISCOURSE I.

ON THE MUTUAL RELATIONS OF THE SCIENCES.

INDEPENDENTLY of the particular views which every science separately presents, there are certain general views which unfold themselves when we contemplate the various departments of Knowledge, in their mutual relations, common features, and joint results. The gratification which is experienced in exploring the field of any single science is of a high character, but we seem to enjoy a still higher order of pleasure when we ascend above the level of that science, if I may be allowed the expression, to cast our eyes on the prospect which spreads on every side, and mark the comprehensive relations and bearings, the lights and the shadows, the contrasts and the harmonies of the whole intellectual landscape.

Of the general speculations which are suggested by such a contemplation of the sciences, several are exceedingly attractive.

It is highly interesting, for example, to direct our consideration to the influence of the sciences on the institutions of society, to trace their utility in the common business of life, and to mark the thousand ways in which they have enabled man to multiply his enjoyments, and to extend his dominion over nature. It is not less interesting to consider their effects upon the mind of man itself; the way in which they have developed and enhanced his intellectual powers, assuaged his appetites and passions, dispelled his prejudices, fostered his finer feelings, and raised him from the degradation of mere animal existence into a moral and intellectual being. And I may mention as a third general view full of interest, a consideration of the marks of power, wisdom, and beneficent design, which all the sciences unite in offering to our admiration.

The view, however, which it is my object to take in the present essay is different from all these, and can prove deficient in attraction only from an unskilful method of exhibiting it to the mind. It is a view of the sciences as connected together by mutual relations, and reciprocally receiving and bestowing light.

A superficial survey might lead us to consider the different departments of human knowledge, as so many separate and insulated objects of pursuit, or spheres of exertion; but a closer inspection will discover that some of them are connected by the most intimate ties; that others which appear at first to have no principles in common and no conceivable affinity, assist in illustrating the same laws of nature or events of time, and that they are all bound together by that common relation which they bear to the human mind and to the happiness of man. In attempting to elucidate this position, it is not my intention, nor would time permit me were it in my power, to undertake a thorough investigation of the subject, but simply to present to the notice of those who hear me a few instances which may lead the mind to a farther prosecution of the subject for itself.

The first topic which naturally suggests itself on entering upon such a design, is the vast influence which the science of Mathematics has had in enlarging our acquaintance with the works of nature. In every department of knowledge where number, quantity, or figure is concerned, where there is anything to be counted or weighed, or measured, or described, the aid of this powerful instrument has been felt. The range of its utility is commensurate, indeed, with the extent to which our organs can penetrate into the universe. Not only the grander facts and principles of nature, the densities and distances, and positions of suns and planets, and all the magnificent phenomena of gravitation, but the devious course and imperceptible velocity of light, the elements of melody and harmony, the forces of those subtile agents the electric and magnetic fluids, the beautiful structure of crystalline forms, nay, even the irregular events and casualties of human life, have been brought within the grasp of mathematical calculation. Its applications indeed are so numerous, that to describe them would be to go through nearly the whole circle of the physical sciences, and since it may be considered as entering into the formation of most of the sciences, or as constituting a part of them, it scarcely falls within the scope of my present design, which is rather to point out the mutual aid which investigations of different classes of natural phenomena afford, than the assistance derived from an instrument of general applicability.

In surveying the whole range of human knowledge, Astronomy is unquestionably that part of it which is most striking to the imagination; and in any general view of the sciences it is entitled to a prominent, perhaps the foremost place. It may be justly regarded as having accomplished more, and as having approached nearer to perfection, than any other department of physical investigation.

That man, the insect inhabitant of a mere point in the infinity of the universe, should have been able to extend his intellectual dominion over masses of matter, revolving millions of miles from the small space on which he stands; that he should have been able to ascertain their laws, assign their periods, calculate their mutual actions and minutest irregularities, is one of those wonders which nothing but their actual achievement can render conceivable. It is the proudest triumph of the human understanding.

Amidst these splendid results, however, we must recollect that it was the extension of a few principles ascertained by experiment on terrestrial bodies, to the celestial phenomena, that led to all those brilliant discoveries which have immortalised the genius of Newton and La Place. To the humble science of terrestrial mechanics we may therefore be considered as originally indebted for the sublime views of modern astronomy.

It is curious to reflect upon the manner in which this debt, if I may so call it, has been repaid; to consider the mode in which the knowledge of the heavens and that of the earth have mutually elucidated each other; to mark the intercommunication of scientific light which has taken place between them. "It is an old but a very striking reflection," says a modern philosopher, "that the only accurate knowledge which man possesses of the surface of the earth, has been derived from the previous knowledge he had acquired of the phenomena of the stars." "Is it possible," he continues, "to produce a more apposite or a more undeniable proof of the universality of Bacon's maxim, that "*knowledge is power*," than a fact which demonstrates the essential aid which man has derived, in asserting his dominion over this lower world, from a branch of science which seems at first view fitted only to gratify a speculative curiosity; and which in its infancy served to amuse the leisure of the Chaldean shepherd?" *

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* Dugald Stewart, Philosophical Essays, p. 36.

The aid indeed which astronomy has afforded us in navigating the ocean, and making ourselves acquainted with the surface of our own planet, is a beautiful and striking instance of the light which one department of knowledge affords to another. A mere allusion to the familiar facts that the latitude and longitude of places are determined by observations of the celestial phenomena, such as the altitude of the sun, the occultation of stars, lunar distances, and the immersion and emersion of the satellites of Jupiter, will be sufficient to bring to mind the peculiar mode and full extent of this assistance. But the process of mutual illustration does not stop here. Navigation and geography, which have been so extensively promoted by the aid of astronomical science, have repaid the benefit by carrying the astronomer to those regions of the earth where he had an opportunity of witnessing phenomena in the heavens which have enabled him to perfect his calculations. Dr. Halley, who himself undertook a voyage to St. Helena to make a catalogue of the southern stars, and who there observed a transit of Mercury over the sun, pointed out to the attention of astronomers the advantages to be derived from accurate observations of the transits of Venus in enabling them to determine the distance of the sun from the earth; and the object of the first voyage of Captain Cook, it is well known, was to observe a phenomenon of this kind, which could be seen to most advantage from some place in the South Sea.

But astronomy has not only been of service in making us acquainted with the geography of our planet, she has extended her assistance in a way which could scarcely have been antecedently imagined,—she has thrown a light upon the darkest pages of history. All the motions of the solar system are performed with periodical regularity. From their first creation the heavenly luminaries have rolled along through the silent deserts of space with that admirable precision, with that exquisite harmony of movement which, though inaudible, may well be called the music of the spheres; and this unerring precision enables the astronomer not only to predict with confidence the position of the heavens at any future period, but to calculate backward and to determine the relative places of the celestial bodies at any given epoch in the past ages of the world. It is easy to imagine how this circumstance may be rendered available to purposes of historical research. Fortunately for this end the superstition of mankind in past times long connected the appearances of the heavenly bodies, particularly the eclipses of the sun and moon, with their civil and political affairs; and as their historians have frequently recorded such astronomical phenomena of the kind as took place near the times of the events which they narrate, it becomes possible for the astronomer to verify in some degree their accuracy, and to fix amidst conflicting testimonies or dubious evidence the precise time,— the year or even the day,—when the event occurred. The precession of the equinoxes is another phenomenon which has furnished similar assistance. Independently of its use in guiding the chronologist through the obscurity of the past, there is something powerfully striking to the imagination in a cycle of changes like this, expanding itself over a period of 25,000 years, and marking with infallible accuracy the flight of ages. A French philosopher has styled it a secular dial,— a dial of centuries,—invented by Providence to reveal its mysteries to studious man.

Thus the astronomer establishes amidst the uncertainty of antiquity a chain of fixed and certain facts; he carries into the darkness of fabulous ages and dubious events a series of luminous points which diffuse sufficient light to afford glimpses at least of their true history. He even (to use the words of a fine poet) attempts to

> "Break through Time's barrier and o'ertake the hour
> That saw the Heavens created."

We are indebted, amongst others, to Sir Isaac Newton for this application of astronomical knowledge. The same admirable intellect which penetrated space, and measured worlds only just visible to the eye, exerted its powers also in piercing the shadowy regions of time, and fixing epochs which had previously vacillated before the sight, and eluded the pursuit of the chronologist and the historian.

It is worth while to pause for a moment and review the links of this beautiful connexion which I have here attempted to trace. First the physical properties of matter on our earth applied to the heavenly bodies, lead to the sublime truths of astronomy. Astronomy in its turn introduces us to an acquaintance with the figure and surface of the globe we inhabit; that knowledge of our own planet is again made use of to perfect our astronomical observations and calculations; and, lastly, even the civil and political history of the earth is elucidated by facts supplied by the luminaries of heaven.

Geology presents us with another striking instance of the intimate dependance and connexion of the various branches of knowledge. It is here that a number of the sciences meet, if I may be allowed the expression, on one common and commanding station. Chemistry, Mineralogy, Botany, Zoology, Comparative Anatomy, History, here assemble, either to lend their assistance in the illustration of facts, or to receive elucidation themselves.

It is Chemistry, for instance, that has explained the complete transmutation into mineral substances of many of those forms of vegetable or animal structure which are termed fossil remains of organised bodies, and which are found so abundant in some of the strata constituting the exterior crust of our globe. By pointing out the different modes of decomposition and recomposition in which the phenomena to be accounted for may be produced, she has precluded all doubt that these various petrifactions, many of which the ignorance of former ages regarded as mere *lusus naturæ*, were really organised substances; or, to speak more accurately, that the spaces which they now occupy were once filled by animal or vegetable matter.

But perhaps the most striking circumstance connected with Geology is the light which has been thrown upon it by the natural history of plants and animals, and by the science of Comparative Anatomy, — branches of knowledge apparently to a casual observer so unconnected with an investigation into the superficial strata of the globe, or at least cultivated as completely distinct provinces, and generally by different persons.

Yet by their aid have naturalists proved, in a manner little short of demonstration, many important facts respecting the vicissitudes undergone by the exterior crust of the earth, and of course by the living beings who have inhabited its surface. They have clearly shown that a whole system of animals existed in former ages of the world, which are now never found—which are, in fact, extinct; that there was once a very different geographical distribution of organised beings from what we now observe; that there have been successive eruptions and retreats of the ocean; and that the sea has remained a long time on our present plains. The geologist has been enabled to arrive at these and other important conclusions from the immense number of fossil remains of organised beings which have been found in various strata of the earth. Without these extraneous fossils, it would have been nearly impossible to form any rational conjecture respecting the vicissitudes to which the surface of our planet had been subjected. Cuvier, the eminent French naturalist, goes even so far as to assert, that had there existed only formations or strata without extraneous fossils, it could never have been asserted that these several formations had not been simultaneous. But the fossil remains themselves would have been of little use without the skill of the naturalist to decypher their meaning—to interpret those mysterious indications of primæval worlds and antediluvian ages with which they were pregnant, both to the eye of science and to that of the imagination. Fortunately, whilst the mineralogist had been delving into the earth, and had not only made himself acquainted with every form which unorganised matter assumes in the most secret recesses of rocks and mountains, but had also brought to light an immense number of bodies which clearly indicated an animal or vegetable origin, the comparative anatomist had proceeded in *his* career with equal rapidity, and had acquired such a thorough insight into the structure of animated beings, as enabled him to supply the assistance which the discoveries of the mineralogist demanded. To such perfection has the science of Comparative Anatomy been brought, chiefly by the labours and genius of the illustrious Frenchman whom I have already named, that the smallest fragment of the bone of any animal is now sufficient to enable an adept in the science to determine the genus or even the species to which it belongs; and by this exquisite and astonishing skill Cuvier has discovered amongst the extraneous fossils seventy-eight different quadrupeds, of which forty-nine are distinct species, entirely unknown, and not at present existing in any discovered country of the world. In mentioning this instance of scientific skill, it is impossible to resist a feeling of admiration at the wonderful mechanism of nature, by which every part of every animal is so nicely and delicately adjusted to every other part, and to the sphere in which it is intended to move, that the least fragment of its structure becomes a sufficient *datum* whence to determine its species,—a basis on which the whole frame of the animal may, to use the language of Cuvier, be reconstructed in its specific figure and dimensions.

The skill of the botanist has been similarly engaged in the examination of vegetable fossils, and has furnished results which, if not equally striking, are yet full of interest and value.

It would require too much time to enter further into a science which is so powerful in awakening both curiosity and imagination, and I shall therefore turn to other subjects scarcely less attractive.

A few years ago the sciences of Chemistry, Magnetism, and Electricity were considered as unconnected objects of study, and as having little relation to each other; but the discovery of that peculiar form of electricity which passes under the name of galvanism, has led to results by which these three sciences have closely approximated. In the hands of Sir Humphry Davy, the galvanic fluid has become the most powerful chemical agent which man can command, decompounding substances which had been long recognised as elementary principles, and presenting to us unknown bodies of novel and striking properties. From the circumstances, that in chemical combinations one of the substances appears to be united with the positive and the other with the negative electricity; that the electric spark affects the union of substances which refuse to unite by other means; that the strongest chemical affinities are destroyed by galvanic agency; that metallic bars are rendered magnetic both in the galvanic current and by the common electrifying machine, and from other corroborating facts, it is evident that these sciences are intimately allied. And when we embrace in our survey the curious phenomena which have lately been pointed out to the attention of the scientific world, relative to crystalline polarity, the magnetising influence of the violet rays of the prismatic spectrum, and the polarisation of light, we appear to obtain indications of some hitherto latent relations and analogies, the further development of which may lead to the most interesting results.

The illustration which Chemistry has afforded to other branches of knowledge has been eminently conspicuous. Passing by the immense services which this science has rendered to the useful arts, as belonging rather to a consideration of its general utility, than to the peculiar view which I am now endeavouring to take, I shall content myself with noticing the light which she has poured on Animal and Vegetable Physiology. It is to Chemistry that we owe a clear and satisfactory explanation of what were a long time close and unfathomable mysteries, the process of breathing, and the source of animal heat; both of which, it is well known, are now accounted for by the union of the oxygen of the atmosphere with the carbon of the venous blood, forming that carbonic acid gas which is expired from the lungs. Nor has she been less useful in illustrating some of the most important processes of the vegetable world. The functions of leaves, the germination of seeds, the maturation of fruits, and the utility of manures, have been explained on chemical principles in a manner, which leaves nothing that is still obscure or unsatisfactory, without a hope of its being ultimately cleared up. In the elucidation of meteorology, she has been likewise successful, and as one of the most beautiful instances of it, I shall mention Dr. Wells's ingenious theory of the formation of dew, a process of nature which has been satisfactorily shown to depend on the principle of the radiation of caloric.

As to the lights which Chemistry has thrown on Medical Science, it would scarcely become me to hazard more than that mere allusion which my subject requires, in the presence of so many who are professionally acquainted, and doubtless well acquainted with the subject. It has unquestionably had a considerable share in the improved aspect of the science, and particularly in disencumbering it of that load of absurd and heterogeneous substances which long disgraced the Materia Medica.

In this notice of the interchange of assistance, and reciprocal elucidation amongst the physical sciences, it would be unpardonable to omit the extraordinary benefits which many of them have derived from the science of Optics, and the art of the Optician. The telescope and microscope (which, though originating in accident, have been so improved by science, that, according to the just observation of an eminent philosopher, she may be almost regarded as their real parent) have opened new worlds to the otherwise narrow vision of the human eye; the one astonishing us with still widening prospects into the immensity of the universe, the other supplying equal objects to our wonder, both in the structure of organic and inorganic bodies, and in the unsuspected myriads of animated beings of exquisite and perfect organization, which seem to lurk in almost every atom of the material world. How much such powerful instruments have aided the progress of Astronomy, Botany, Entomology, Physiology, and other sciences, it is unnecessary to explain. Without such aids, indeed, some of them could scarcely have existed.

One remarkable example of the accession brought by optical science to our knowledge of the heavenly bodies (and the more remarkable, as being independent of the great astronomical instrument already named), I cannot refrain from particularly adverting to; I mean the scientific achievement of the distinguished French philosopher, Arago, who, during his investigations in physical Optics, was able to determine by a fragment of Iceland spar, whether the light of the Sun proceeds from the solid body of that luminary, or from a gaseous envelope around it; and whether comets are self-luminous, or shine only by reflection. Whose imagination would have been bold enough to conceive beforehand, that a property in a common crystal could be made to advance our knowledge of celestial bodies millions of miles distant from our globe?

It is another beautiful example of the principle I am endeavouring to illustrate.

I have hitherto confined my remarks, chiefly at least, to those sciences the object of which is to bring us acquainted with the laws and properties of material substances; but there is another class of sciences, which are devoted to the consideration of the intellectual and moral principles within us, and to the actions, position, and progress of mankind. And surely, if to mark the relations which connect the physical sciences, and the modes in which they mutually illustrate each other, be an object of utility and interest, it cannot be either useless or uninteresting to pursue a similar investigation with respect to departments of knowledge that relate to the mind and the career of man, and to note also how far the same reciprocity of elucidation and assistance has taken place between these separate classes.

The philosophy of the human mind, in its most comprehensive acceptation, includes every enquiry which relates to man as a moral, intellectual, and social being. Amongst other things, it comprises the consideration of the methods by which knowledge is to be pursued. There must, obviously, be one department of intellectual exertion—one branch of science—which must consist in taking a survey of all the sciences; in marking their relations, objects, and methods; in pointing out the logical principles on which they proceed; in investigating the efficiency of the mental instruments with which they are pursued (namely, the faculties of the human understanding); and in ascertaining the limits which nature has prescribed to our curiosity, that we may not waste our exertions in the prosecution of enquiries beyond the reach of our powers. This is an important part of Mental Philosophy. It is the science which Lord Bacon calls the *Philosophia prima*, and of which one of the most important applications has received the name of the *inductive philosophy.* Of its utility in regard to other sciences, Lord Bacon's own writings form a conspicuous example. It is in vain that we pursue truth, unless we set out in the proper path. For how many hundred years had Natural Philosophy made no real progress, merely from the ignorance of mankind as to the precise objects and true method of scientific research! Lord Bacon, whose comprehensive mind surveyed the whole field of intellectual exertion, had the merit of forcibly and distinctly explaining them, and of foretelling the felicitous and wonderful results of experimental enquiry. This *prima philosophia*, however, which has led to the inductive method of philosophising, need not detain us farther for our present purpose, since it is unnecessary to use many words in showing how such comprehensive views of human knowledge must beget improvements in the methods of pursuing the sciences, and, consequently, in the sciences themselves. I shall merely add, that as this part of philosophy has had a most important share in the discoveries of modern science, so those discoveries, in their turn, have reflected light upon the true general principles on which scientific enquiry ought to proceed; and it is not too much to assert, that, in like manner as Astronomy has been carried to a degree of perfection which Newton, with all his genius, never reached, so the principles of the inductive philosophy have been improved into a state of perspicuity, explicitness, and practical utility, superior to that in which they were left by the master-hand of Bacon himself. This result, indeed, was predicted by that great philosopher, with whom it was a favourite maxim, that as the sciences advanced, the methods of invention and discovery would partake of their progress. And it is highly probable, that our present methods labour under defects, which a more accurate scrutiny may detect and remove. It has been observed, for instance, that a more thorough insight into the nature of the relation of cause and effect, a subject belonging altogether to metaphysical enquiry, would be extremely likely to free physical science of many of its errors, and simplify the labours of the philosopher, by confining his attention to its legitimate objects.

The advantages of the inductive method of philosophy,—a method which may be briefly described to consist in observing facts and discarding fancies,

—have been chiefly felt in the rapid advancement of our acquaintance with external nature; but the success attending physical investigation has had an important reflex influence on moral and intellectual, or what are generally termed metaphysical researches. When philosophers had abandoned the search after essences and universals, and other visionary entities, by which they formerly hoped to penetrate the mysteries of the universe; after they had discovered that man, in the language of Lord Bacon, is but the interpreter of nature, and can know nothing but what he observes in the external world and in his own mind,—a truth which is the basis of the inductive philosophy,—they devoted their attention, in the first place, to the physical phenomena around them; and, in the brilliant success which attended their investigations, they appeared to overlook that the phenomena of their own mental constitution demanded an examination according to the same method. As they could not, however, avoid occasional incursions into the regions of mind, they naturally and perhaps unconsciously carried along with them the habits of induction formed in their physical researches; and although the truth was a long time dawning on their understandings, they at length perceived that the same principles apply to one department of enquiry as well as to the other,—that the same logical procedure is required in both. The mere logomachics of the schools, the fruitless controversies whether mind was extended or unextended, whether it had any relation to space, what was its essence, and the like, have been consequently swept away; and it is now acknowledged that in the science of mind, as well as that of matter, our business is to observe and record, and to form general conclusions from a careful induction of particular facts.

Thus, physical investigation has in its turn reflected light in several ways upon mental philosophy, which, though hitherto comparatively neglected, is sure to receive a large share of future attention, and will probably one day lead to results far more important to mankind, though less immediately striking, than any which have issued from their researches into the properties of matter.

There is yet another way in which the influence of one of these great departments of investigation upon the other has been manifested. The connection between matter and mind—between the facts of bodily organisation and of consciousness—has been greatly elucidated of late years by physiological research into the nervous and cerebral apparatus both of the lower animals and of man. And although consciousness must ever remain a province to itself, separated by a chasm, if I may so express it, which physical investigation can never pass, yet it is something not to be contemned, to trace physiological action to the very brink of the chasm, —to connect particular organs, movements, and impressions of the bodily frame with those mental properties and processes, the laws of which we can become acquainted with only by self-introspection. It has tended, I think, to improve our classification of psychological phenomena, and enabled us to discriminate more clearly our natural and acquired faculties and functions.

One or two further instances of the relation of the philosophy of mind to other pursuits are deserving of notice, before we dismiss it from our consideration. The strong lights which it has thrown on the principles of the fine arts are familiar to all who have attended to the subject. The application of the doctrine of association to the theory of the sublime and beautiful has opened many new views, and although we cannot expect that the artist will imbibe any inspiration from a metaphysical exposition of the principles of his art, yet it is the unquestionable tendency of enlightened speculations on the origin of our sentiments of sublimity and beauty, to expand our conceptions and to purify and establish our taste; and it may be remarked in general, that as the poet, the painter, and the sculptor have to operate on the feelings and passions of mankind, *he* will be most likely to succeed (other circumstances being the same) who is best acquainted with the laws by which they are governed.

But the noblest instance of the aid which the science of mind has afforded to other subjects, is the admirable explanation it has furnished of some of the phenomena of political society;—I here allude to the science of Political Economy, which may be almost regarded as a branch of Mental Philosophy, and has its foundation in the uneradicable principles of the human mind. It is a synthetical application of these principles to the ordinary business of men; and it was to a professor of Moral Philosophy habitually engaged in explaining the nature of our mental constitution, that the world was indebted for the Treatise on the Wealth of Nations, a work which has had more influence—silent and slow and imperceptible, but progressive and increasing—on the domestic regulations of the European states, or rather of the civilised world, than any other that could be named within the last century. Nor must it be wholly overlooked that mental science has lent valuable aid to the legislator in dealing with the hitherto but partially solved problem of the best methods of preventing and punishing crime; while it has taken out of the class of offences certain acts which only ignorance and bigotry could have placed there, and, by elucidating the principles of evidence, has contributed to the improvement of jurisprudence in relation to that important subject.

In drawing to a conclusion, I will take one moment to allude to the light which the labours of the Etymologist, confined as they appear to be to the mere elucidation of words, have recently cast upon the intellectual history of Man. Horne

Tooke, in his "Diversions of Purley," Humboldt, Prichard, and other modern writers, have thrown much illustration, not only on the formation of particular languages, but on the procedure of the mind in the creation of a medium of communicating its thoughts and feelings. They have most ingeniously shown, or rather the verbal genealogies which they have traced enable us to perceive, how language gradually raises itself from the scanty vocabulary of a few nouns and verbs, expressive of sensible objects and motions, which the necessities of man's condition have extorted from his lips, into that copious and regular system of terms, indicative of shades of meaning, and mental processes, and abstract relations, to be found amongst a refined and enlightened people, proving that language, although the necessary result of man's organisation, is an instrument of communication and thought gradually elaborated, through a succession of ages, into coherence and perfection.

The researches of the scientific Etymologist* have also elucidated the natural and civil, as well as the intellectual history of mankind. "Languages," it is remarked by Humboldt, "are the only monuments which have reached us of the early ages of the world," and certainly they furnish the only indications of which we can now avail ourselves in tracing the origin of nations, their customs, and their affinity, at a period to which the records of history do not reach. It is an examination of the structure of various tongues which has enabled the philosophical inquirer to determine, that all the inhabitants of Europe (except some inconsiderable tribes), along with the Hindus and the Persians, have descended from one race. This common origin, says the learned Dr. Murray, appears from language only; and there is no doubt that a close investigation of the languages of other parts of the globe would furnish grounds for ascertaining whence or how they were peopled. This, in fact, has been partially accomplished.*

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* This branch of enquiry is now usually denominated Comparative Philology.

Perhaps the power of knowledge never appears in a more striking point of view, than when it enables man from present data to penetrate into the secrets of days gone by, and bring to light facts which seemed to have irrecoverably vanished in the confusion or the silence of ages. The instances of this kind adduced in the course of the present essay are not only interesting in themselves, but are eminently illustrative of the principle which I am endeavouring to unfold. We have seen Astronomy ascending to the highest antiquity, and ascertaining phenomena which took place thousands of years before the birth of modern civilisation: we have seen Geology disinterring from their long oblivion, monuments which transport the mind over a vast interval of time, to a state of the world so different from its present condition, that it can have passed from one to the other only by a series of extraordinary vicissitudes; and we now see the lowly science of Etymology, which has been stigmatised as the mere drudge of Literature, pointing to the origin of nations, and tracing the tide of human population as it flowed over the wild and desert regions of ancient Europe.

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* See the Discourse, in the present volume, on "Changes in the English Language," where this interesting subject is resumed at greater length.

Such are some of the most striking instances which have occurred to me of that connection and that reciprocity of illustration amongst the various departments of human knowledge to which it has been my object to call your attention. Nor can we be surprised that the sciences should lend this mutual aid, when we come to reflect that the end or purpose of all investigation is to make us acquainted with the properties of matter and of mind as they exist at present, and with the history of the phenomena which have resulted from them in past times. It is therefore what might have been antecedently expected if we find that an investigation into some of these properties sheds a collateral illumination upon others, and that the common relation of all the sciences to the mind which explores their principles, frequently combines the rays which they individually afford, and pours their collective light on the same object.

But although, on close reflection, it is not surprising to find these mutual relations—this commerce of elucidation—amongst the sciences, it is a circumstance highly useful and interesting. Not only may we entertain, from the past advancement of knowledge, the most sanguine anticipations of the progress of the sciences in their separate careers; but, from the instances I have adduced, we may look forward to an increasing tendency in all of them to lend mutual aid, and to assume more and more the aspect of a grand, continuous, and harmonious whole. Nor is this a benefit merely because it accelerates the progress of discovery; but it is equally so, by enabling the mind to grasp the sciences with greater ease. Insulated particulars, unconnected truths, are acquired and held with difficulty: the more we multiply the points of connection, the more we bind them together by correlative facts and common principles, the easier they become to understand, to retain, and to apply.

It is this connection among the sciences, too, which renders it impossible that, where they are at all cultivated, the proscription of any one particular branch of knowledge or field of enquiry should succeed in its object; that any system of error whatsoever should be permanently upheld; or, what is equally consolatory, that any system of truth should be ever overthrown. Hence the confident expectations we may form of the ultimate triumph of moral truth (whatever that truth may be) in every country, however despotical its government, where physical research is permitted or encouraged. We might as well hope to throw midnight darkness upon a body by protecting it from the direct rays of the sun while it is left exposed to the reflected light of the atmosphere, as expect that the most despotic prohibition of moral enquiry should preserve it from the influence of that glorious effulgence of truth which the curiosity and enterprise of man are permitted to pour on every other department of human investigation. That TRUTH on every subject will finally prevail is the dictate of sound philosophy no less than the hope of true benevolence; and I cannot better close this long discourse, than after having conducted my hearers to so exhilarating a conclusion. I leave them at a point whence the glowing prospect of human improvement stretches before the intellectual vision, bounded only by the incapacity of our faculties to traverse its extent.

[This Discourse was first read as long ago as 1823, and has undergone only a few subsequent alterations, such as the introduction of M. Arago's experiment, and a few other matters of minor consideration. Had the author had to compose it during the year which is just expiring (1851), he would probably have illustrated some parts of it by additional facts that have come to light in the interval; but, as the case stood, he thought it better to allow the Discourse to remain (with the exceptions just named) as originally written, since the unfolding of the principle is of more importance than the fulness or even freshness of the illustrations. A large modification of that kind might too, if he may venture to say so, have impaired the harmony of the composition, and by introducing a multiplicity of details have weakened the impression as a whole, which a single Discourse of this kind, intended to present one connected and comprehensive view, ought, like a poem, to make on the mind.]

DISCOURSE II.

ON THE MAMMOTH OR FOSSIL ELEPHANT DISCOVERED AT THE MOUTH OF THE LENA.

It will be in the recollection of many members of this Society, that, in more than one of our geological discussions, allusions have been made to the discovery of a Mammoth or Fossil Elephant at the mouth of the river Lena. Having, soon after those discussions, had occasion to consult one or two works in which the details of this discovery are given, it occurred to me that a short account of it, and of the principal theories which had been formed in reference to it, might be acceptable to the Society, and fill up half an hour at some of its meetings when there was nothing of greater novelty and interest to occupy the attention of the members.

In order to render the subsequent account more intelligible, it may be necessary to premise that the Lena is a river in Eastern Siberia which rises near the lake Baikal, not far from Irkutsk (about lat. 52° and long. 104° from Greenwich), and at no great distance from the northern boundary of the Chinese Empire; and which, after running a course of 3450 geographical miles, discharges itself into the Frozen Ocean. The situation of its mouth appears to be in about 71° 30′ north latitude, and 127° east longitude from the meridian of Greenwich.* This high latitude is sufficient of itself to denote that the climate is rigorous and inhospitable. Constant frost binds the soil of this bleak region, except during a short-lived summer, when the ground is thawed scarcely four feet in depth. The long extent of coast which stretches from Nova Zemlia to the north-eastern termination of Asia, presents nothing, for at least eight months out of the twelve, but a solid sea of polar ice: and even during the short interval of summer, the ice seldom secedes far from any part of the shore. From some parts it is questionable whether it ever secedes at all; and although many expeditions have been undertaken to explore this coast, it does not appear that the whole space has been completely navigated.†

It was in the year 1799, that a Tungusian chief of the name of Schumachoff, who was in this quarter for the sake of hunting, observed among the blocks of ice a large shapeless mass, which he examined on all sides without being able to discover its nature. The next year the object had become more disengaged from the ice, and in the summer of the following year (1801) the same chief, on his annual excursion, first perceived that it was a gigantic animal, the whole of one side and also one of the tusks being completely laid bare. The summer of 1802 being less warm than the preceding one, the Mammoth appears to have been again blocked up by the frost; but in the subsequent year, the ice which supported the body of the animal having given way, the whole enormous mass fell upon a sandbank.

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* Account of Billings's Expedition to the Northern Parts of Russia, by M. Sauer.

† Account of the Arctic Regions, by William Scoresby, vol. i. p. 315.

When thus first exposed to view it appears to have been unmutilated, and in all respects entire, with its hair, skin, and flesh in full preservation. Schumachoff described the animal as so fat and well fed that its belly hung below the joints of its knees. A drawing was made of it by the Tungusians, accompanied by a description; but these were done in so rude a style as to furnish no accurate idea of the animal as it was first seen.

Soon after the body had been found on the sandbank, the chief Schumachoff cut off the tusks and sold them. The Iakutski, inhabitants of the neighbourhood, fed their dogs with the flesh, and what was not consumed in this manner appears to have fallen a prey to the bears, wolves, foxes, and other wild tenants of that wintry region.

The remains of the animal were in this state, when a Mr. Adams, who was at Iakutsk, a town on the Lena about four hundred miles from its mouth, first heard of them, and determined to visit the spot where they lay. He was accompanied in his visit by the chief before mentioned, who originally discovered this extraordinary beast.

The place where Mr. Adams found the Mammoth was about sixty paces distant from the shore, and nearly 100 paces from the escarpment of ice from which it had been precipitated. He describes this cliff of ice as about two miles in length; and in that part of it where the Mammoth had been imbedded, its perpendicular height was 35 or 40 toises. It consisted of a clear pure ice, and was covered with a layer of earth and moss about 14 inches deep. The Tungusians affirm, that when the animal was first seen, it was seven feet below the surface of the ice.

Mr. Adams found the Mammoth greatly mutilated. The skeleton, however, still kept many of its bones united, and it was almost entirely cleared of its flesh, remaining whole with the exception of one fore leg. Several bones were still held together by the ligaments and parts of the skin; the head was covered by its skin, and a tuft of hairs was upon one of the ears. The proboscis and tail were gone. The skin, of which about three-fourths were recovered, was of a dark grey colour, covered with a reddish wool and hairs and stiff black bristles, and it was of such extraordinary weight that ten persons found a difficulty in transporting it to the shore. Of the hairs which had been trodden into the ground by the wild animals while devouring the flesh, Mr. Adams collected 36 pounds. The dimensions of the carcase are given as follows: height, 9 feet 4 inches; length, 16 feet 4 inches from the point of the nose to the end of the tail. The tusks are 9 feet 6 inches measuring along the curve, and weigh together 360 lbs. avoirdupois.

The head alone, without the tusks, weighed 414 lbs.

Mr. Adams immediately set to work; arranged and separated the bones, and had the whole put up and transported to Petersburg. He had likewise the good fortune to re-purchase the tusks. The skeleton thus nearly complete, is now in the Museum of the Academy of that city; and part of the skin and hair, which were sent to Sir Joseph Banks, were presented to the Museum of the Royal College of Surgeons in London.

The Mammoth is a species of elephant, but, according to M. Cuvier, different from either of the two species living in the present day in Africa and India. It agrees, however, more nearly with the latter than the former.* The specimen discovered in the manner just narrated, corresponds in its specific characters with the other remains of elephants which are occasionally dug up in various parts of Europe, and must obviously be referred to the same period.

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* It is distinguished from them by the teeth, and the size of the tusks, which are 10 to 15 feet long, much curved, and have a spiral turn outward. The alveoli of the tusks are also larger, and are produced farther. The neck is shorter, the spinal processes larger, all the bones of the skeleton stronger.

It may also be necessary to state that it differs in its generic characters from the immense animals found on the banks of the Ohio and other parts of America, although they have frequently received the same appellation. These latter belong to the genus Mastodon of Cuvier, which is entirely a fossil genus, and of which no living species has been hitherto discovered. Of this fossil genus five species have been found. The first species, called the Great Mastodon, is equal if not superior in size to the largest race of elephants, to which the whole genus is more nearly allied than to any other animal. The skeleton of one which I myself saw in the United States of America, and which had been dug up in the State of New York in the year 1801, was reported to be 18 feet in length, and 11 feet inches in height.

In confirmation of the preceding narrative, it may be proper to notice that there is nothing singular or extraordinary in the perfect preservation of the animal. The antiseptic properties of frost are well known. Animal food, says Scoresby, may be taken to Greenland and preserved any length of time. M. Bleau, in his Historical Atlas, informs us that the bodies of seven Dutch seamen who perished in Spitzbergen in 1635 were found twenty years afterwards in a perfect state, not having suffered the smallest degree of putrefaction.* The same causes which preserved these bodies for twenty years might, it is obvious, have preserved them for two hundred or two thousand. These are the chief particulars which I have been able to gather respecting the discovery of the Mammoth at the mouth of the Lena: I may add that it is not the only instance of a fossil animal being found with its integuments still upon it. In the year 1771 the carcase of a rhinoceros in a state which was described as that of a natural mummy, and emitting an odour like putrid flesh, was discovered on the banks of the Vilhoui, a tributary of the Lena. Part of the skin was covered with black and grey hairs in considerable profusion.

The frequent discoveries of the remains of animals at present alien to the climates in which they are found, even when they consist of mere bones, are calculated strongly to rouse the curiosity of the most indifferent mind, pointing as they indubitably do at vast revolutions (either vast in the force exerted, or vast in the results and in the time occupied in effecting them) which have at successive periods altered the surface of the globe, and the most recent of which must be referred to an era many thousand years before our time. But a double interest is excited when not only the remains of the skeleton, the most durable part of the animal structure, and which it is readily conceivable might retain its form and even its substance through an indefinite period, are presented to us; but when the entire animal starts up before us in its perfect figure and freshness, just as it roamed through these wilds in the full vigour and animation of life, hundreds of centuries before the period of its disinterment. It seems a messenger from those remote ages silently but forcibly proclaiming the flight of time; or rather it brings those distant ages and our own so directly into contact, that the interval between them, in which generations after generations have risen and perished, empires flourished and faded, and all that distinguishes the history of our species has been accomplished, appears to shrink into a mere span, and the drama of the world passes before our eyes as a momentary pageant.

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* Scoresby's Arctic Regions, vol. i. p. 341.

Nor is the entire preservation of the animal merely a circumstance more imposing to the imagination; it furnishes us with peculiar data, as we shall have subsequent occasion to notice, whence important inferences may be drawn to aid the investigations of the man of science, and may be said, without exaggeration, to have thrown new light on the theory of the earth.

The whole account is so extraordinary that it is impossible to hear it without speculating on the several hypotheses which have been or might be formed to account for the animal being found in the situation and under the circumstances described. The question is evidently one belonging to the science of geology, and requires a consideration of the other analogous facts which this science supplies. If the remarkable phenomenon which forms the subject of this paper had been an insulated occurrence, to be accounted for by some local or individual cause, I should never have thought of introducing it to the notice of this Society: but it is manifest that the solution of the problem involves the general question of the character and circumstances of some of the great changes of which the surface of the globe has been successively the theatre.

With these preliminary remarks, I shall proceed to examine three different hypotheses or theories in reference to the present subject. The first is, that the Mammoth was transported by the Deluge from a tropical region to the coast of Siberia; the second, that it lived in the country where it was found, but under a very different climate from that which now prevails; the third, that it was not only a native of the region in which it was discovered, but existed in the same rigorous climate which predominates there at this day, and was specifically adapted to it.

For the sake of easy reference, we may briefly term them the theories of Diluvial Transport, of Change of Climate, and of Specific Adaptation.

The first hypothesis, which supposes the Mammoth to have been transported from a tropical climate, is that, perhaps, which naturally suggests itself first to the mind. It requires no extravagant assumptions—no agents but such as are known to have operated—no convulsions or revolutions but those of which we are generally supposed to have proofs. The cause assigned seems also competent to the effect produced, and the hypothesis might be received as a satisfactory explanation, were there no facts at variance with the conditions necessarily implied. We must therefore look to the difficulties which surround it rather than the arguments in its favour, and these are of no insignificant character.

Although we may readily imagine the possibility of a violent flood transporting a body of any kind to almost any distance, yet it is difficult to conceive (what this hypothesis requires) that an animal of such extraordinary bulk should be carried at least three or four thousand miles without being mutilated or dismembered or assailed by chemical decomposition.

Another curious circumstance, which goes far in my opinion to render the hypothesis untenable, is the existence of an immense number of bones of the Mammoth race throughout the whole of Siberia. There is not, says Professor Pallas, in all Asiatic Russia, from the Don to Behring's Straits, a stream or river in the banks of which they do not find the remains of elephants and other animals now strangers to that climate. These are washed out by the floods during the thawing of the snows, and are collected by the natives, who sell the tusks as ivory. Almost all the ivory used by the Russian turners is from the fossil tusks of Siberia, and they even form an article of export. Although many thousands have been annually obtained for a long series of years, they are still found in great abundance on the banks of the rivers, and in yet greater abundance on the shores of the Frozen Ocean. In digging wells or foundations for buildings, entire skeletons of elephants are everywhere laid bare, well preserved by the frozen soil. Nor is it merely the Mammoth race which is thus profusely scattered through the diluvium of Siberia. The bones of the buffalo, the rhinoceros, and other animals, are also found in extraordinary plenty.

At the mouth of the Lena and of other rivers, whole islands seem to be formed of these various animal remains. In Billings's account of an expedition to the northern parts of Russia, there is a short notice of a journey over the Icy Sea in a northerly direction from the estuary of the Yana, performed by a person of the name of Lachoff. This adventurer discovered two islands. The first, with the exception of three or four inconsiderable mountains, is composed of ice and sand; and when the shores fall, during the partial thaw of summer, the tusks and bones of the Mammoth are found in great numbers. According to the testimony of Chvoinoff, a Russian surveyor, who also visited the island, it is formed of the bones of this animal, mixed with the horns and bones of the buffalo and the rhinoceros. The second island presented similar appearances.

Now the abundance of these bones is itself a strong proof that the animals were inhabitants of the region where they perished, and where their relics are found. It must have required generation after generation to die and deposit their remains on the spot in order to produce the surprising phenomena here described.

This conclusion is further supported by the fact that the bones are not rolled, or, in other words, worn in their angular parts, as they probably, if not inevitably, would have been, had they been conveyed from a great distance by the force of a flood.

Another objection to the hypothesis that they have been transported from a southern region is to be found in the circumstance, that the traces to be perceived of diluvial action indicate the current to have been from the North. This is particularly insisted upon by Professor Buckland with regard to Europe; and in America Dr. Bigsby has traced the action of a violent flood from the North in the vicinity of Lake Huron.

This hypothesis has also to contend with all the arguments adduced with so much ingenuity by Professor Buckland, to prove that the Kirkdale cave was an hyæna's den; for it is obvious that the same arguments which establish the former existence in

Yorkshire of animals now only known as tropical, would serve to prove that the organic remains found in the diluvial beds of Siberia are those of animals anciently indigenous to that country.

The theory of diluvial transport has been strenuously supported by Granville Penn in a recent publication, which is not likely to have much weight with geologists, and which I have not had an opportunity of examining with much attention. To the objection that the bones of the animals found in the north are not rolled, he replies that they may have been transported thither while their integuments were yet upon them; and as to the southern direction of the current, which is admitted by him in common with others, he supposes that it must have been followed by a reflux in a northerly direction, and that it was these refluent waters which carried along with them the animal remains existing in such plenty in the arctic regions.

The second hypothesis which I have mentioned regards the Mammoth as a native of the region where it was found, but supposes that the climate of the country has undergone a change from a torrid to a frigid temperature. Such a change is supported by no direct evidence whatever, although it is undoubtedly countenanced by the extraordinary abundance of the remains of animals which are now known as existing only in warm regions, such as the rhinoceros, hippopotamus, and tapir, as well as the elephant; of none of which are there now any species living except in the torrid zone. Whether this phenomenon does not admit of another explanation will be examined after we have noticed the greatest difficulty, perhaps, which lies in the way of the hypothesis under consideration. It has to contend with the formidable objection, that if any such change of climate took place, it must obviously have been instantaneous, as the Mammoth must have been frozen at the moment of its death, or within a brief period afterwards; otherwise it could not have been preserved in the condition in which it was discovered. "If it had not been frozen," says Cuvier, "as soon as killed, it must quickly have been decomposed by putrefaction. But this eternal frost could not have taken possession of the regions which these animals inhabited except by the same cause which destroyed them; this cause, therefore, must have been as sudden as its effect."

Now it is difficult to conceive that this extreme and instantaneous change of climate could have been effected by any other means than a change in the inclination of the axis of the earth; and the only physical agent we can fix upon as capable of producing such a tremendous catastrophe is a comet.

Wild as the supposition may appear to be, that one of these erratic bodies crossing the earth's orbit should strike our planet so as to alter its axis, it has the authority of no less a name than that of La Place.

After observing the small probability of such an event in the short course of individual existence, this illustrious astronomer proceeds to say, "that this probability may, nevertheless, become very great if considered with respect to a long series of ages. It is easy to imagine," he continues, "the effects of such a shock upon the earth. The axis and rotatory motion being changed, the seas abandon their former position, and rush to the new equator: great part of the men and animals drowned in this universal deluge, or destroyed by the violence of the shock; entire species annihilated; all the monuments of human industry swept away; such are the disasters which might ensue from the shock of a comet. We see therefore," he adds, "why the ocean has formerly covered the high mountains, on which it has left indubitable marks of its presence; how the plants and animals of the south may have existed in the climates of the north, where their remains and impressions appear; and lastly, by an event of this kind, we may explain the novelty of the moral world, the regular processes of which can scarcely be traced beyond 3000 years."

This hypothesis of a change of climate is favoured by Mr. Buckland, and has been recently supported in the Edinburgh Review. The writer of the article alluded to makes use of the argument to which I have already adverted, considering that the fact of crocodiles, tortoises, vegetables, and shells, allied to those peculiar to hot climates, being found in secondary strata, as well as in the diluvium of high northern latitudes, renders it probable that the temperature was warm." Dr. Fleming, on the contrary, thinks that if all the conditions of the problem had been examined before attempting its solution, the supposition of a change of climate would not have been an article in the creed of any geologist. The argument from the fossil remains of the elephant, rhinoceros, and tapir derives its chief support, he thinks, from the prejudices associated with these names. At the mention of an elephant the imagination, he observes, immediately presents us with the picture of an animal browsing in an equatorial forest, guided by a Lascar or hunted by a Caffre; but as investigation proves that the Mammoth is a species of elephant different from any existing species, the circumstance of its being of the same natural genus is in no way conclusive as to the climate in which it lived.

On the other hand, the quantity and characters of the hair found on the Lena Elephant demonstrate that it was a species suited to reside in temperate and cold regions—which is the third hypothesis we have to examine. The circumstances just mentioned are undoubtedly much in favour of the opinion that there has been no change of climate. It is universally found that the clothing of animals living in cold countries is different from that of animals of warm regions, both in quantity and arrangement. The covering of swine, for instance, in warm climates consists of bristles or hair of the same form and texture, while in cold climates it consists not only of bristles, but of fine frizzled wool next the skin, over which the long hairs project. Now between the elephant of warm regions, which is thinly covered with short hair, and the Lena elephant, which had abundance of strong bristles of great length with equal abundance of short wool, there is precisely the sort of difference which is here described, proving that they are also severally adapted to different climates. This is decidedly the opinion of Cuvier—an authority on such a subject scarcely to be surpassed. The integuments of the Mammoth, he says, afford an undeniable proof that this animal belonged to a race of elephants with which we are now unacquainted, inhabiting a cold region, and by no means fitted to dwell in the torrid zone.

The chief objection to this last hypothesis is the difficulty of accounting for a sufficient supply of food in these wintry regions. The elephant, it is well known, is an herbivorous animal, and a full-grown one is said to consume daily from 100 to 150 pounds weight of vegetables. On the supposition that the climate of Siberia was as intensely cold during the existence of these elephants as it is at present, how could they subsist in such numbers in a country so destitute of vegetation? "The Mammoth," says the article before mentioned in the Edinburgh Review, "if capable of bearing the rigor of a Siberian winter, must have wanted sustenance, unless a totally different state of the vegetation had also existed." This difficulty, certainly, seems on a first view almost insurmountable, but part of it will probably give way when we consider the subject with more attention. From the scanty accounts which we have of the regions bordering on the Icy Sea, we find that the effects of the intense cold are not such as to exclude animal existence. Rein-deer are numerous; bears, wolves, foxes, wild sheep, and other animals are also constant inhabitants. Lachoff, whom I have before mentioned as having travelled on the Icy Sea to the north of the Yana, states that he saw an immense herd of deer going over the ice southward. Great numbers of these animals are slain annually in August, when they retreat from the Icy Sea to the forests. It is further stated that the Yakuti, who inhabit the banks of the Vilhoui, Aldan, and other rivers, are immensely rich in cattle. All these facts prove that the country, cold as it is, possesses considerable resources in the vegetable productions of its soil, for I scarcely need to state that it is the soil which ultimately supports the animals, whether herbivorous or carnivorous (except a few which live on fish), which I have enumerated. In all cases, with that exception, the degree of productiveness in the soil forms the limit to their numbers.

Besides this indirect evidence as to the existence of vegetables capable of sustaining animal life, we have direct information that brushwood and creeping willows extend to the Icy Sea, and that the larch will approach to within 30 versts (22½ miles) of it. Farther in the interior, the whole country of Siberia seems to be diversified by large forests,—grass is plentiful in the plains during summer, and cryptogamic plants, a hardy race, flourish during the severity of winter.

Vegetation, indeed, exists in greater abundance in these high latitudes than we are apt to suppose. In countries long covered with snow the temperature of the earth is considerably higher than that of the air, and thus preserves it in a state proper for vegetation notwithstanding the intense cold of the atmosphere. The rein-deer subsist great part of the year on the *lichen rangiferinus*, or rein-deer moss, which grows in great abundance, and which the animal contrives to reach under the deep covering of snow by which it is guarded from the frost.* We even find vegetation taking possession of the ice itself. We are told in the narrative of Lachoff's excursion, to which I have already alluded, that in the second island the surface is a bed of moss of considerable thickness, producing a few low plants and flowers. This moss may be stripped off like a carpet, and the earth underneath appears like clear ice, and never thaws.

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* Captain Cochrane informs us, that during his travels in Siberia he scarcely ever saw a place where the horses could not, by scraping with their feet, reach the earth in search of food.

When we take into account all these vegetable resources, and that the elephant of tropical climates, in a wild state, feeds on grass, shrubs, and the leaves and younger branches of trees, the improbability of the Mammoth finding sufficient sustenance in the frozen tracts of Siberia becomes considerably lessened. The latter country (to recapitulate what has been stated) produces abundance of trees, if not immediately on the coast, at least in the interior; shrubs, even to the very verge of the Icy Sea; grass, in the short summer which visits these parts with almost intense heat; and great plenty of cryptogamic plants beneath the snows of winter. Here then are the constituents of the food of elephants; and if we suppose that the Mammoth periodically migrated like the rein-deer, which we are told betake themselves in winter to the interior forests, and retreat to the borders of the Icy Sea in spring to shelter themselves from the flies and insects then infesting those forests*, we appear to obtain a plausible solution of the problem.

Viewed in every light, however, the subject is beset with difficulties; and if I am disposed to regard this last hypothesis as encompassed with the fewest, and to have a preponderance of evidence in its favour, I by no means think that we have sufficient grounds at present before us for drawing any very positive conclusion. The ear of science should never be closed against fresh evidence, and we have yet much to investigate and much to learn in that department of inquiry to which the present question belongs. Many of the countries within the tropics have never been geologically explored. The nature of the organic remains lying beneath their surface is unknown; and we are therefore deficient in many facts which may hereafter be brought to light and furnish grounds of decision on the general question now under review.

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* "Professor Owen, in his excellent History of British Fossil Mammalia, 1844, p. 261. *et seq.* observes, that the teeth of the Mammoth differ from those of the living Asiatic or African elephant in having a larger proportion of dense enamel, which may have enabled it to subsist on the coarser ligneous tissues of trees and shrubs. In short, he is of opinion that the structure of its teeth, as well as the nature of its epidermis and coverings, may have made it a meet companion for the rein-deer." *Lyell's Principles of Geology*, page 80.

[I have thought it best to print the preceding discourse pretty much as it was delivered above twenty-five years ago, adverting in the present note to some facts and opinions regarding the subject of it, which have since transpired. The chief of these, worthy of remark, appear to be the following, which I have taken from the seventh edition of Lyell's Principles of Geology.

1. Two other mammoths, with flesh upon them, were found in Siberia in the year 1843.

2. Some interesting facts have been adduced by Mr. Darwin, to show that the quantity of food consumed by herbivorous animals of a large size has been generally overrated; a consideration which tends to lessen the difficulty respecting an adequate supply of food in the case of the Siberian mammoth.

3. A theory has been proposed by Sir Charles Lyell, which, renouncing the supposition of any violent change, considers the

climate of Siberia to have become more rigorous than formerly, in consequence of a gradual elevation and extension of the Siberian lowlands to the north; and that it is to a period anterior to this extension, when a higher but still moderate temperature prevailed, that we are to refer the occupation of the now inhospitable region by the gigantic elephants and other animals at present alien to the soil where their remains are so abundant. This theory appears to get over two difficulties besetting the hypothesis of no change in the temperature, viz., the scanty supply of food in so rigorous a climate, and the extinction of the races of animals once inhabiting the country; the latter of which circumstances is left unaccounted for, if we suppose all the physical characteristics of the region to have continued unaltered.]

DISCOURSE III.

ON THE CHANGES WHICH HAVE TAKEN PLACE IN THE ENGLISH LANGUAGE, ESPECIALLY DURING THE THREE LAST CENTURIES.

To trace the progress of the sciences, to mark the small beginnings from which they sprung, and their gradual advancement to the farthest point to which they have attained, has always been justly regarded as an occupation of the highest interest by those philosophers who have been engaged in their pursuit and conversant with their principles. And even persons who are acquainted only with the great facts thus brought to light, and are incapable of entering into the processes concerned in the results, are gratified to follow the general course of discoveries, by which they feel that human power has been enlarged and human nature exalted.

In a similar way, but with the animation of much wider sympathies, we are all interested in the general history of our race, and the particular career of kingdoms and communities, and even individuals. Wherever, indeed, there is a succession of events in which men are the agents or the patients, we love to follow them out, to mark their connection, and to watch their issue.

There is one series of this kind, however, which seems to have attracted little notice, even amongst philosophers, till a recent period, although it concerns all mankind, appeals both to their curiosity and to their sympathies, and is not only worthy of close investigation, but well able to repay it. I mean the successive changes which have taken place in the languages of the world, and more especially in the language which we are constantly in the habit of employing.

Such changes are in fact connected with the history of the human race in a way on which few have probably reflected. While a comparison of the more permanent parts of various languages enables us to trace the migrations of tribes and nations, and their descent from a common stock, an examination of the changes in the idiom of any particular country enlightens us in regard to many points of its fluctuating domestic condition.

If it were possible to strip a language of the modifications and contributions of successive ages, we should find, at every step, curious and instructive indications, beyond what are furnished by historical records, of the varying knowledge, arts, customs, occupations, modes of thinking and feeling, passions, and prejudices of different generations, till at length we should arrive at a rude instrument of communication corresponding to the rude ideas of the barbarous race who employed it. We should then see clearly, if we had not seen it before, that the knowledge and the language of a nation must be co-extensive; that a barbarous people with a limited stock of information can have only a limited stock of words; and that as their ideas multiply, they invariably invent for themselves or adopt from their neighbours adequate modes of expression.

With the origin of language I do not purpose, on the present occasion, to occupy your attention at any great length, but I cannot forbear remarking, on this subject, that an attentive study of the human organisation can scarcely fail to satisfy us that the utterance of articulate sounds is just as natural to man when his organs of speech, in the progress of his individual growth, have reached a certain stage of development, as is the act of walking when the muscles of his legs have acquired a certain consistence and strength. And in whatever circumstances human beings might reach this stage, however isolated they might be from intercourse with others of their species, they would inevitably invent a language for themselves: they would no more remain mute than, after a certain maturity of their limbs, they would remain motionless, or be content to continue on the same spot of ground.*

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* In a very instructive paper in the "Smithsonian Contributions to Knowledge," vol. ii., "on the Vocal Sounds of Laura Bridgman," by Francis Lieber, some light is thrown on this subject. Although this poor girl is a blind deaf-mute, incapable of hearing her own voice, yet so strong is the natural instinct for speech, that she utters a variety of articulate sounds. They are chiefly for persons, not things or actions, and no fewer than sixty in number.

What particular sounds, indeed, they would utter, what designations they would give to particular objects, it may be difficult, and even impossible, to specify; just as we are unable to specify the particular movements and gestures, which would be the result of their locomotive efforts. It is natural to suppose, at least, that the utmost which could be done in the case would be to indulge in some *à priori* speculation as to the sounds most likely to be uttered; to hazard a few uncertain guesses, formed from a consideration of the natural tones of passion, combined with the action of such faculties as imitation and association, in given circumstances, on the power of speech. The active spirit of modern research and analysis, nevertheless, has been on the alert here, as elsewhere, and not suffered the question to remain unexplored. A bold attempt was made a few years ago, by Dr. Murray, to reach the object, which has just been supposed accessible only to conjecture *à priori*, by an *à posteriori* method; by taking an actual language, analysing its combinations into monosyllables, investigating the changes undergone by these monosyllables, according to certain principles which he points out, and thus penetrating to the primary acts of articulation.

In this way he traces the words in the languages of Europe through all their transmutations back to the very first articulate sounds uttered; till, in fact, he arrives, or thinks he arrives, at the original monosyllables.

My hearers will smile at being told that he ventures to assign, not only the number of these original monosyllables—nine,—but even the words themselves. Nay, he goes further: he states that, in the infancy of language, "the nine primitives, slightly varied in articulation, were the whole vocabulary. Connective and adverbial words were not used. Speech resembled a series of interjections." "It appears to be probable, though perhaps this may be reckoned by some an imaginary statement, that AG, or WAG, was the first articulate word uttered by our barbarous progenitors."*

In reference to this extraordinary attempt, you will, probably, not be surprised at the severity of the sentence pronounced upon it by a recent author, who says that Dr. Murray blends the rarest erudition with the most ridiculous theories.†

Although the attempt to arrive at the very first words uttered, may be hopeless and even irrational, yet this by no means shuts us out from tracing speech to a very rude condition, and discerning the principles concerned in the transformation of words.

The alterations which a language undergoes in the progress of a people from ignorance to knowledge, from rudeness to civilisation, and from one stage of refinement to another, are not, in the main, accidental, whimsical, or arbitrary, but arise from the laws of human nature acting under the various circumstances in which men are placed.

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* History of the European Languages, vol. i. p. 271.

† Dr. Wiseman's Lectures on the Connection between Science and Revealed Religion, vol. i. p. 55.

In regard to this point at least, I may avail myself of the observations of Dr. Murray: "All the changes in the language of Europe," he says, "or, what is the same thing, in its dialects, have been subject to certain laws, not of an anomalous, arbitrary, or irrational nature, but such as have arisen from the mind of tribes and nations exerting its powers on the mass of hereditary speech, that the purposes of communication might be obtained or promoted." *

There are two great classes of such changes which may be here pointed out—alterations in grammatical forms, or what may be termed structural changes, and alterations in the vocabulary of a language, or lexical changes, although a definite line cannot always perhaps be drawn between them, the former often implying the latter.

Of the first kind we have indisputable examples in those languages which have lost the inflections in which they formerly abounded, and have gradually substituted independent words, such as prepositions and auxiliary verbs, to express the same circumstances. We have other instances in the transformation of verbs and nouns into those apparently unmeaning particles when considered alone, which we call prepositions and conjunctions—a part of the subject which has been explained with

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* History of the European Languages, vol. i. p. 198.

great ingenuity by Horne Tooke in his "Diversions of Purley."

Of the second kind of changes examples sufficient will be brought forward in the course of my present essay, and it will not be needful to do more here than barely refer, for the sake of clearness, to such innovations as the introduction of new words and the disuse of old ones.

In respect to structural changes, there are two essentially different views entertained by comparative philologists. Dr. Murray's opinions may be taken as exhibiting one of these modes of regarding the subject. He considers that speech was originally monosyllabic; that in the infancy of compounded languages all circumstances (such as time, manner, voice, mood, and the rest) were expressed by separate words, which were long moveable, and possessed a distinct sense. The combinations thus formed, originally long and harsh, of which the parts were self-explanatory, were softened by attenuation, aspiration, and elision of the consonants and subsequent contraction of the vowels. The circumstantial or consignificative words were at first merely added or prefixed; afterwards they became corrupted, and were called inflections and terminations. In process of time, the use of them as such was forgotten, and they were dropped, circumlocution of one kind or other supplying their place.* Another author, Mr. Welsford, in a more recent treatise, which I have just taken up, maintains there is strong ground for believing that one primitive language prevailed amongst mankind; that it was monosyllabic; and that probably of this language not a single root is lost.*

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* History of European Languages, vol. ii. p. 323—331.

He goes on to say, "if the primary language of mankind was monosyllabic, as I believe it to have been, it necessarily follows that all dissyllables, trisyllables, and tetrasyllables, are not words but sentences, that is, combinations of words." "When etymology," continues Mr. Welsford, "by a diligent analysis of all existing languages, as well refined as rugged, written as unwritten, shall have discovered all the radical syllables with their exact original signification, we shall perhaps find that all the words in every language are made up of a small number of radicals perpetually recurring and variously combined, as all the articulate sounds of every language are represented by about from fourteen to twice or thrice as many letters."† The theory of these philologists has some strong facts in its favour.‡ That languages may exist composed of monosyllables and without inflections, is proved by that of China, and by the dialects of the South Sea Islands, examined and compared by Humboldt. In these idioms every word in a sentence stands by itself as a significant expression, as an integer subject to no modification; and this extends to words indicating grammatical relations—characteristics which are common to the Eastern Polynesian languages with the Chinese.*

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* On the Origin and Ramifications of the English Language, p. 242.

† Ibid. 243.

‡ It may be here mentioned that the sounds uttered by Laura Bridgman, as stated at page 53., are all monosyllabic.

The other party of comparative philologists entertain views essentially different.

If I understand them rightly, they maintain that languages were not all originally monosyllabic, and devoid of inflections; that they did not acquire their peculiar grammatical structure by slow degrees, but received it at first and at once from some mysterious energy of mind, which the human race no longer possesses.

Thus the celebrated Frederick Schlegel, as cited by Dr. Wiseman, "speaks not indeed of language as given to man by superior communication, but considers the mind of man so to have been organised, as necessarily to produce, on his first appearance, this well-ordered and beautiful structure, and thereby supposes its oneness and indivisibility." †

Dr. Prichard seems to have entertained a notion somewhat similar; although, as far as I have investigated his works, he does not maintain that language came out from the human mind at once a beautiful structure, but speaks of a diversifying tendency, a habit of language-making actively at work in the first ages, but which afterwards ceased for ever to exist or operate.*

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* Researches into the Physical History of Mankind, by Dr. Prichard, vol. v. p. 19.

† Lectures, vol. i. p. 110.

William Von Humboldt, who, like Schlegel and others, regarded speech as a necessary and spontaneous result of man's organisation, also speaks of a mysterious or unknown intellectual power presiding at the creation of languages, and (as we must suppose) subsequently disappearing.†

Between these two schools of philologists, there appears to me to be a similar difference to that which subsists between two geological schools of the present day — the catastrophists, who ascribe many changes on the surface of the earth to extraordinary convulsions; and the more patient or less vivacious theorists, who see nothing in such changes but what, if the requisite time be allowed, ordinary causes at present in operation are fitted to produce.

The principal ground on which Schlegel and his co-theorists rest their opinion is, that we cannot find in the past history of speech any language which, from being monosyllabic, and devoid of inflections, has become polysyllabic and inflectional. The experience of several thousand years does not, according to Dr. Wiseman, afford us a single example of spontaneous development in any speech. At whatever period we meet a language, we find it complete as to its essential and characteristic qualities.

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* Researches, vol. iv. p. 224, 225.

† Wiseman's Lectures, vol. i. p. 80, 81, 82.

Granting all this for the sake of argument, I am not able to see how it warrants the conclusions drawn from it.

The phenomena to be accounted for are, that some languages are monosyllabic and non-inflectional, while others abound with polysyllables and inflections. On the hypothesis that speech was, in every case, originally monosyllabic, it is not difficult to conceive that, after the unavoidable dispersion of those who spoke it while it was still in a rude condition, some of the tribes thus formed might meet with no circumstances to alter the simple structure of their language as it expanded with their increasing knowledge, till the habit of using its pristine grammatical forms had become a second nature; while amongst other tribes the early occurrence of certain incidents (as for example the appearance of a man of powerful and original mind) might almost, at the outset, give rise to composite phrases, which would be imitated and multiplied, and in process of time slide into what we term inflections.

In the two supposed cases, the tribes, while their speech was still unformed and immature, would take a different start from the same ground, and *that* would determine the subsequent course of their grammatical history. This is surely a simpler hypothesis than ascribing the inflectional structure of a language to the sudden operation of a mysterious energy in mankind, which passed away for ever when its business had been accomplished. Such a supposition, I confess, appears to me as wild as any thing in the speculations of Dr. Murray.

We may in our turn ask, where do we now witness such abrupt transitions in the human mind, or where are they to be found in recorded history? Further, if there was only one original language, and *that* language was at the very outset polysyllabic and inflectional, how are we to account for the existence of languages consisting wholly of monosyllables, such as the Chinese and the Polynesian? It is difficult to conceive that a polysyllabic language should ever pass into a monosyllabic one, and leave no vestiges of its ancient composite character. Speech, I believe, as fully as Humboldt himself, to be the immediate result of man's organisation. Further, the regular grammatical structure, more or less complicated, to be found in the rudest languages, may be allowed to indicate not merely a capacity for uttering articulate sounds, but an inborn aptitude in mankind to fall into those syntactical forms and observances which, varying widely with circumstances, are, under some modification or other, indispensable for the clear and consistent communication of thought and feeling.

There is nothing, however, in all this requiring other faculties than those which mankind now possess.

We see, it is true, no languages in the process of spontaneously developing themselves in inflections and terminations, for the simple reason that those we are acquainted with have already settled down into particular forms, which serve the purposes of the people who use them, and are consolidated by habit. It is one thing for a language to be gradually moulded into a new shape while in its infancy, rude, scanty, and indeterminate, and another to undergo that process when it has been amplified and established through a long lapse of time by daily custom, and written or remembered records. I hazard these remarks with diffidence. Comparative philology, to which the foregoing questions belong, not only has recently made, but is still making, great progress, especially in Germany; and, as it would be premature to speak with dogmatism on a subject still under investigation, what I have said has been thrown out rather as a suggestive contribution to an interesting discussion than for the purpose of advocating a theory.

One great fact or series of facts appears to have been established to the satisfaction of such inquirers as have given the closest attention to the science, viz. that a group of nations who have received the designation of the Indo-European family, in which the inhabitants of the British Islands are included, have had one common origin, and that the several dialects of the members of that family have sprung from one common language.

"The comparison of languages," says a recent writer, "has shown that innumerable centuries before the beginning of Grecian and Italian history, the common ancestors of the Hindus, Persians, Greeks, Romans, Germans, Slavonians, and Celts, formed *one* nation, which proves itself to have attained no contemptible degree of civilisation by a well-regulated family-life,—by its cattle-breeding, its agriculture, domestic settlements, navigation, measuring of time, as well as by a considerable store of intellectual resources. How completely," he adds, "this dispels the deceitful illusion that in Greece every thing had a Greek beginning."*

It follows from this that each nation of the family group here described must have passed at a very early stage of the separation through a very different process of thought and action from the rest, in order that the results—the several languages actually spoken—should come out so widely dissimilar both in their grammatical structure and in their vocabulary. If the language common to the whole were originally monosyllabic, it must be presumed to have lost that character previously to the *one* nation splitting into distinct tribes, unless a very long subsequent period is allowed. So far as written records take us, the languages of the latter are polysyllabic and inflectional, although in the progress of time some of them have lost great part of their inflections, and substituted in their place ticles, prepositions and auxiliary

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* The Results of Comparative Philology in reference to Classical Scholarship, by Dr. G. Curtius, translated from the German, p. 10.

process undergone by our own dia-
the eleventh and the fourteenth cen-
glo-Saxon, which, with its inflections
uliarities, had been the prevailing lan-
country, gradually dropped them and
present grammatical structure, in other
me transformed into English.
am, after remarking that "nothing can
fficult, except by an arbitrary line, than
nine the commencement of the English
," proceeds to speak of the discontinuance
Anglo-Saxon inflections: "this," he says,
rought about so gradually, that we are not
d from much of our difficulty as to whether
compositions shall pass for the latest offspring
e mother, or the earlier fruits of the daughter's
lity." "It is a proof of this difficulty," he
s, "that the best masters of our ancient lan-
ige have lately introduced the word Semi-Saxon,
ich is to cover every thing from A.D. 1150, to
.D. 1250."*

These few observations on the origin and the structural changes of our language, will serve to introduce the immediate object of my essay, which is, to draw your attention to those changes more directly affecting its vocabulary that have supervened subsequently to its having assumed its present grammatical structure. A language long after it has settled down into its regular etymological forms and syntactical arrangements, and even after it has been established in some degree of steadfastness by the productions of eminent writers, continues to undergo important variations in the number and meaning of its terms. "The import of words," says an able writer, "changes with the times; their signification enlarging with the progress of knowledge. Languages are every moment perishing in detail from the variations introduced by custom: they grow old like those that speak them, and like them gradually alter their features and their form." *

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* Introduction to the Literature of Europe, ch. i. vol. i. p. 57, 58.

In the last three or four centuries, during which most of our standard authors have appeared, our language has undergone a number of such mutations, and it is these that I am at present about to consider. They may be comprehended under the following heads:—

1. The introduction of new words.
2. The union of existing words into new compounds, including their junction with current prefixes and terminations.
3. The discontinuance of words formerly in use.
4. The alteration of meaning in words still employed.

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* Bailly, History of Astronomy, quoted in Stewart's Elements, vol. ii. p. 360.

The limits of a short discourse would not permit me to enter into the full consideration of all these changes even were I competent to the task, nor can I pretend to proportion my attention precisely to the importance of each. On this point I shall rather be governed by a desire to present to you the most interesting examples which happen to lie within the sphere of my knowledge.

1. The causes which introduce new words into a language are various. They never, perhaps, have been more actively at work in adding to our own than during the last hundred years. A new dictionary which I have lately had occasion to consult professes to have 20,000 more words than Johnson's, which is reckoned to contain 38,000; while the American lexicographer, Webster, calculates that his portly volumes number about 70,000.

All the causes of this great increase sink into insignificance compared with one to which I have already alluded; or, perhaps, it would be more accurate to say that they may be comprehended with scarcely an exception in one general description, viz. the progress of knowledge, the accession of new ideas, the discovery of new substances, new forms, new combinations, new methods of classification and research, new principles. All these require, as they arise, appropriate terms to denote them; and as terms to suit cannot be found already made, the vocabulary in use must be enlarged to meet the exigency, partly by novel combinations of language, but chiefly by the introduction of new words. It is almost needless to point out the way in which the sciences have thus forged for themselves forms of expression in proportion as they have advanced. A simple reference to the interesting and rapidly improving departments of research, Botany, Chemistry, and Geology, will be sufficient to bring to the minds of my hearers the precise manner in which the vocabulary of a science expands to meet the demand upon it. On these occasions the classical languages of Greece and Rome, particularly the former, are unscrupulously, I had almost said unmercifully, laid under contribution—unmercifully, at least, to the student who has to encounter these learned derivatives. As the tyro glances along the vista before him, the pathway of science seems stopped up by what may be described as huge verbal blocks, masses of syllabic aggregations, which both the tongue and the taste find it difficult to surmount. Who has not been astounded at meeting with such terms as *pterodactyle*, *megalosaurus*, *ichthyodorulite*, *acanthopterygian*, *nothochlæna-trichomanoides*, *bifrenaria-aurantiaca*, *monopleurobranchian*, and the rest of that formidable phalanx!

Every one, however, who has reflected on the subject, must be aware of the impossibility of doing without them. We who profess a taste for Anglo-Saxon simplicity are in this respect victims to the rapid progress of science, and must submit to our fate, happy that the current language of literature and common life, although perpetually subject to the invasion of new phrases, is only now and then disturbed by the intrusion of the more stupendous of these designations.

One hint I would beg, with all diffidence, to throw out for our men of science in the construction of their nomenclatures and terminology. M. du Ponceau, in his account of the American languages, tells us that they are very rich in compound terms, expressive singly of many circumstances and incidents, which it takes us a whole sentence to designate, forming, in this respect, a striking contrast to the Polynesian languages before described. Thus, by one polysyllable, cited in Heckewelder's correspondence with the gentleman just named, the Lenni Lenape Indians express what takes us seven monosyllables and three dissyllables, viz. "come with the canoe and take us across the river." This polysyllable is *nadholineen*, and it is formed by a combined process of abbreviation and what M. du Ponceau terms *agglutination*, that is, in simpler phrase, by taking parts of several words, and cementing them into one. In a similar fashion, when a Delaware woman, as we are told by M. du Ponceau, is playing with a little dog, she will often say to it, *kuligatschis*, meaning "give me your pretty little paw." The word is compounded as follows: *k* represents *ki*, the pronoun of the second person, and means *thy; uli* is part of *wulit*, pretty; *gat* is part of *wichgat*, a paw; and *schis* is a diminutive termination.*

Now I would suggest to our men of science, who are already adepts at agglutinating polysyllables, that if they would take a lesson from the Lenape and Delaware Indians, and learn to abbreviate before they agglutinate, they might bring their verbal aggregations into a more manageable compass. The Indian process, it is true, results in polysyllables also, but they are often formed from small parts of words, while our scientific nomenclators glue long words together with little or no abridgment.

To return from this digression: the English language, although containing many composite words, admits of few new combinations of independent words into real compounds for scientific purposes; and nothing is more difficult than the invention of a purely arbitrary, unrelated term; or, perhaps, it would be more correct to say, more difficult than the introduction of such a term into use. There must be some connection with a former term, or name of a place, or of a person, a bridge, as it were, to enable the mind to pass over to the new word. Invention in language does not proceed *per saltum*. The intellect here will *march*, but it usually refuses to *leap*.

It is amusing to notice the expedients sometimes resorted to in the imposition of proper names, in which this principle of the mind is conspicuously exemplified. The names of almost all our towns and villages are pregnant with an ascertainable meaning; and if we turn to the distant regions we have invaded, we find the same system of verbal propagation. The appellations given to towns, and districts, and countries, and rivers, when they are not indigenous, as Ontario, or Canandaigua, or Missouri, are either transferred from places in the Old World, as New York, New Holland, Richmond, Troy, Utica; or taken from the names of persons, as, Baltimore, Raleigh, Washington, Boothia, Louisiana, Melville Island; or they are general terms combined and converted into proper names, as the Cape of Good Hope, Montreal, Newfoundland, Botany Bay. No name is absolutely new, insulated, unrelated. It seems to be a law of Nature, that after the first creation, words like animals, must have parents of their own species.

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* Prichard's Researches, vol. v. p. 309.

The Greek language comes admirably to our aid in this emergency, as it regards terms of science. In the infinite combinations which it admits, every new object, and operation, and phenomenon, may find some term partially indicating its sensible qualities, and thus fastening itself to the memory of those who are able to understand its latent import. Barbarous as these words would doubtless be to the ear of an ancient Greek, could he be recalled to life to hear them, and harsh as they often are even to us, we are happily free from the thousand associations through which they would excruciate his feelings.

I may also notice that we are indebted for some scientific terms to our continental neighbours; and to Germany and Sweden in particular, for names of minerals. Here we have again to bow, however reluctantly, to the mandates of science, and to admit as graciously and pronounce as well as we can, *grauwacke*, *floetz rocks*, *tungsten*, and *muschelcalk.*

To France, too, we are under obligation for some excellent additions to our vocabulary. Passing by scientific technicalities and military terms, I will content myself with adducing as an instance, the admirable general word *tact*, which is so recent as not to be found in Johnson.

It may appear like being thankful for small things, but in these days of long words, new monosyllables, when legitimately come by, can scarcely be too highly prized. Even *cab*, which we have recently acquired by abbreviating the French *cabriolet*, may be cordially welcomed; and *mob*, gained by a similar operation on *mobile* (whether Latin or French is not material), dating as far back, at least, as the days of Dryden, is invaluable.

Commerce also has imported a number of exotic names with exotic things from the more distant regions of the globe: palanquin, bungalow, typhoon, gazelle, mocassin, wampum, calumet, and a host of others, many of which being soft and musical, and not debased to us by low associations, have assumed a place in poetic diction.

I have had occasion to mention instances of common terms being formed into proper names. There are instances also of the reverse process, the conversion of proper names into common terms. I may cite the well known substantives *spencer*, an article of dress, and *sandwich*, an article of food, taken from the titles of noblemen, and the still more recent verb, *macadamise*, and adjective *mackintosh*, the origin of which you all know as well as I do. Galvanism, Mesmerism, Talbotype, Daguerreotype, and a hundred other formations of a similar kind, will so readily suggest themselves as to spare me the necessity of further illustration.

2. The next class of changes mentioned in my list, namely, the combination of existing words into new ones, will not detain us long. There are two kinds of such compounds; those which consist of two or more independent nouns or verbs joined together, and those which consist of a single noun, or verb, or other word, united to a prefix, or a termination.

The English language contains many compounds of both kinds.

Of the first kind, many, from long use, have come to form one word, in which the meanings of the component terms are merged in that of the compound, as *sweetheart*, *blockhead*, *honeysuckle*, where we never think of a heart, or a block, or of honey; while others still continue to keep in view the separate meanings of both the component parts, as *sun-beam*, *sea-prospect*, *plum-tree*.

It is scarcely to be expected that we should find many recent compounds in which the separate signification of each element is lost, or even many such introduced in the lapse of the last three centuries. Of those in which it is preserved, there are numbers created almost every day. In fact, they may be multiplied *ad libitum*, just as we may multiply the *ap*position of adjectives to substantives without *com*position. They may be considered as double, rather than compound words—yoked together, not incorporated, and resorted to, for the most part, from that propensity to abbreviation, on which I shall have hereafter to enlarge. Such are manifestly the double words so abundantly employed in poetry, *incense-breathing*, *heaven-planted*, *feather-cinctured*, *ear-piercing*, *dew-bespangled*, *sun-bright;* the elements of which may be regarded as united for the occasion—as partners for the dance, not for life.

For the reasons I have given, it is evident that new combinations of this kind cannot, for the most part, be considered as additions to the vocabulary of the language, and do not, consequently, come within the present division of my subject.

The same, however, cannot be said of compounds formed by joining the common prefixes or terminations to nouns and verbs, and in some instances particles, with which they have not before been united. These may be considered to be real additions to our vocabulary. As an instance of a new word formed in this manner, I may cite the term *international*, introduced, it is said, by the late Mr. Bentham, to denote a relation for which a short phrase was much wanted. Being also legitimately formed, it was instantly adopted, and is now used by the purest writers. Another instance, singular from its being formed by affixing a substantive termination to a preposition, is the word *outness*, which first appeared, I believe, in the pages of Bishop Berkeley.

The formation of these words, simple as it is, well exemplifies that principle before alluded to, which is continually at work in modifying language, and is, in truth, the main source of all compound words whatever,—a desire, namely, in the human mind, to escape from circumlocution, and to express its meaning in a direct manner,—to reach its object by the shortest road; although this desire, being liable to be overborne by more ambitious motives, cannot certainly be affirmed to be a prevailing one amongst public speakers and writers. With this rather important reservation, we may adopt the language I am about to quote. "The human mind," says a French author, "desires to do its work quickly, more eager to express itself promptly, than anxious to express itself with exact and deliberate precision. If it has not at hand the instrument most fitted for the occasion, it makes use of one within its reach."* It is the doctrine of Horne Tooke that the first aim of language was to communicate our thoughts; the second, to do it with dispatch. He adds that the latter has had much the greater share in originating the different sorts of words.†

The same propensity has led to the formation of many other words falling under the present head, such as *industrial*, *congressional*, *reimbursable*, *talented*‡, *rationalistic*, *sensationalism*, some of which I own, particularly the three last, are yet barbarous to my own ear, although they have been found convenient. They show the strong tendency of the mind to prefer a single word, an adjective or a substantive, to a phrase consisting of several, or even two, words, one of them, perhaps, a mere particle.

In compliment to our brethren across the Atlantic, I will mention an adjective coming under this division, which is worthy, I think, of being accepted at their hands, I mean *lengthy*. It could have sprung up nowhere but in a country addicted to protracted oratory, and is a modern instance of what forms a fascinating feature in the study of etymology, namely, the power of words to indicate the habits and customs of those who used them. At present, this epithet carries with it a slightly sarcastic, or what Jeremy Bentham termed, a dyslogistic implication. Had England been favoured a century ago with many seven hours' speeches, like Lord Brougham's on law-reform, she would have undoubtedly anticipated America in the invention of so expressive a designation.

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* M. le President de Brosses, quoted by Horne Tooke, Diversions of Purley, vol. i. p. 27.

† Diversions, vol. i. p. 26, 27.

‡ For this anomalous and objectionable epithet there is no precedent except perhaps *gifted;* but the latter is at all events allied to the verb *give*, while the former has nothing to appeal to but a noun.

Notwithstanding a repugnance to neologisms in common speech, there is one which, as I am in a commercial district, I would venture to propose, and to which I think good taste might soon be reconciled. At present, it is common to use the participle *manufacturing* as an adjective in such phrases as "the agricultural and manufacturing interests," which is awkward enough. From this awkwardness the introduction of the legitimately formed word *manufactural* would relieve us.

3. We come next to the discontinuance of words formerly in use. The learned author of the History of Hallamshire, Mr. Hunter, complains grievously, of this class of changes. "Custom," he says, "is for ever introducing new words into our vocabulary, and blotting out others which had kept their station in it with honour for centuries. Custom," he continues, "is a very capricious power. Nothing can be more arbitrary, nothing can betray the want of any settled principle more completely, than the way in which she has dealt with the vernacular

language of the English nation. She has abolished some of our best words, and introduced others, which had no claim to currency amongst us, beside the stamp of her authority." *

He gives as examples, amongst other words, *rode* or *raid*, a marauding expedition, and used in that sense in the Bible; and to *breed*, used by Shakespear in the sense to *accord with*—

> "She speaks,
> And 'tis such sense, that my sense breeds with it."

He further cites to *calve*, used by Milton to denote the act of separation or disparting:

> "The grassy clods now calved."

These are instances of words that have become completely obsolete. He also enumerates a few which appear to be undergoing the process of obsolescence, such as *peradventure*, *tarry*, *damsel*, *jeopardy*.†

Agreeing with Mr. Hunter in lamenting the loss of some words now antiquated, I cannot agree with him in looking upon these changes as merely arbitrary and capricious; that is to say, I regard them for the most part as changes, not indeed conforming to any prescribed rule, but depending on certain principles of the human mind, and which admit of being accounted for, although the task may be difficult. It is, I submit, incredible on the face of it, that the unconnected and separated individuals composing the writers and speakers of a whole nation, should be seized with the same mere whim or caprice for discontinuing a good old word. Such a general discontinuance, like any other event depending on the concordant acts of a number of persons without any possible concert, points to some common principle as its cause.

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* The Hallamshire Glossary, Introduction, p. vii.

† Ibid.

One obvious principle on which some words are dropped in the progress of time, is, that the acts or customs which they designate are discontinued, or the objects have ceased to exist. When this happens, it is a less effort on those rare occasions, when we wish to refer to the act or the object, to make use of a periphrasis or general term, than to retain a word merely for the especial purpose. A word cannot easily keep its place in the national vocabulary unless it is habitually wanted. Its intelligibility may, indeed, be preserved by its frequent appearance in books not yet laid aside, but it will not be employed in current conversation or writing, and may consequently be considered as antiquated. On this principle, I am persuaded, many words have disappeared. The occasions for using them have been so infrequent that they have in fact been forgotten, or if remembered at all, remembered with effort. This will account for the disuse of the term *rode* or *raid.*

Another cause which has great influence both in the obsolescence of words and in the next process of mutation which I shall have to consider (viz changes in meaning), is the desire of the mind to shake off mere synonymes; a fact which is often expressed by saying that it is the tendency of language to clear itself of synonymes. In reference to this and other phrases of a similar kind, I may take occasion to observe, that they are sufficiently correct modes of signifying the facts, and not apt to mislead, if we bear in mind that the tendency of a language to do so and so, can be nothing else than the propensity of the beings who employ the language.

Now it happens that the English language has been rather encumbered with synonymous terms from its composite character. As it is one which has not gradually enlarged itself to its present size without foreign assistance; but has been on several occasions, and from various sources, swelled by the intermixture of other tongues, the consequence has been a multitude of words of this description. Hence it has continually happened that writers and speakers have had to choose between a word derived from the Saxon or some cognate dialect, and one derived from the Greek, Latin, or French, both originally implying the same idea; and as for many centuries the education of literary men was almost exclusively classical or scholastic, it is not wonderful that they should have manifested a bias in favour of the latter, and gradually disused the homely synonymes derived from the Saxon or the Danish, some of which are found at present only amongst the vulgar.

The word *straightway* is an example in point: although often found in Spenser, Shakespear, Bacon, and the Bible, it has yielded in modern usage to *directly* and *immediately.*

The same principle is at work in clearing the language of synonymous terms when they are all Saxon or of mixed derivation, although the reasons why the word retained is preferred to the word dropped are not always easy to trace. *Halt* and *lame* are both of Saxon origin, yet the former as an adjective has become obsolete without any apparent cause of disfavour, except it be its liability to confusion with the verb *halt,* when the latter is used to signify stopping on a march or in any onward movement. So long as the adjective continued in use, to call out halt to the lame would be ambiguous.

Peradventure, one of the words the disuse of which is regretted by the author last named, had to contend with three formidable competitors, *haply, perchance,* and *perhaps;* and it could scarcely be expected that they should all be retained in current use. The love of brevity may have decided the struggle in favour of *perhaps,* in preference to *peradventure,* and the liability of confounding *happily* and *haply* may have occasioned the disuse of the last.

Another cause of the disuse of words once prevalent is a progress in refinement, which does not permit certain acts and objects to be mentioned or referred to without circumlocution. This refinement has sometimes extended so far as to banish words which have any strong similarity with such phrases in sound, although not in sense or derivation; and it has led to the avoidance of terms which have become debased by vulgar or other disagreeable associations. I am, on this head, precluded of course from the most striking examples. The words *squab* and *settle*, both signifying a kind of sofa, may, however, be mentioned even to "ears polite," as coming under the latter predicament, which is also the case with *nook*, once in frequent use with the poets and to be found both in Shakespear and in Milton. The latter says,

> "Search through this garden, leave unsearched no *nook*."

It may have owed its degradation to such alliances as are seen in the provincial compounds, *ash-nook* and *chimney-nook*.

Another circumstance tending the same way, that is, to throw words out of use, is the continual desire to get quit of words really different in meaning, and frequently in derivation, although identical in sound, and thus liable to create confusion. One or two of the examples of Mr. Hunter appear to be cases in point. The verb to *breed*, for instance, or, more properly, the two verbs to *breed*, would continually occasion mistakes if used both in the sense of *accord with* and in that of *procreate*. Hence the former sense, or former word, the least useful of the two, has been allowed to drop. A similar remark is applicable to the word *calve* (or *cave*, pronounced with the Italian *a*), as used by Milton.

The neuter verb, *wax*, in the sense of *grow*, has probably been discontinued from its identity in sound with the product of the bee-hive, which supplies an active verb, as in the lines of Dryden,

> " He form'd the reeds proportioned as they are,
> Unequal in their length and wax'd with care."

The verb *wax*, too, in the sense of grow, is not needed, as we have abundance of synomymous expressions; on which account alone it would run the risk of banishment; and it is, if I may judge from myself, never used in that acceptation, without intruding upon us also the much livelier and more tenacious idea of its cognomen—a somewhat incongruous reminiscence. Thus, several causes may have conspired to throw this verb out of use—similarity to another in sound, liability to call up the image of the object denoted by the latter, and the existence of synonymous terms. The causes here assigned appear to me sufficient to account for the disuse of most words which have become, or are becoming, antiquated.

4. Let us now turn to the last class of changes, and to me, I confess, the most interesting—changes, namely, in the meaning of words which we still

continue to employ, although with an acceptation partially or wholly different from that which they formerly bore.

As it is not my object to furnish a catalogue to show the extent of these changes, but an account of the principles on which they take place, my examples need not be numerous.

Some of these alterations consist simply in a limitation of meaning, where a word was formerly used in several senses, and resemble some of the cases already adverted to. They seem to depend on the same principle—the desire to confine one word to one acceptation, for the sake of perspicuity. We have an instance of such a mutation in the word *incomprehensible*, which is thus noticed by Dr. Mant, in reference to a passage in the Athanasian Creed, where the persons of the Trinity are spoken of as, the Father *incomprehensible*, the Son *incomprehensible*, and the Holy Ghost *incomprehensible.* "In the Latin," says he, "in which this creed was first penned, it stands thus: 'the Father *immense*, the Son *immense*,' &c. When this translation was first made in our native tongue, the word *incomprehensible* was not confined to the sense it now bears, as inconceivable or beyond, or above our understanding, but it then meant, not comprehended within any limits, and answered to the original expression and notion of immensity."

This acceptation, I need not say, has completely vanished, and no person who in these days hears the Athanasian Creed, except here and there a scholar, thinks of any other meaning than what is conveyed in the periphrasis, "beyond the human understanding."

The word *punctual* may be cited as having undergone a similar limitation of meaning, and in all likelihood from the same cause. It was formerly applied to space as well as time, but now seems to have shrunk within the narrower limits of denoting exactness in keeping engagements, or in attending to appointed hours. In writers of no remote date we find such phrases as, "a punctual description," "a punctual relation," "a clear, full, and punctual declaration," to express what we should probably now denote by *particular*, or *circumstantial.* Sir Thomas Brown has "a punctual truth." A writer of the time of Charles I. uses the expression, "to speak punctually to the points;" * which reminds one of the old joke, "gradually by degrees."

We have a remarkable instance of this limitation of meaning in the word *commodity*, now seldom used, except to denote articles exposed for sale, or merchandise, but anciently employed in the sense of advantage or convenience. Thus Spenser, the poet, in his "View of the State of Ireland," speaking of the Irish mantle or cloak, says, "The commodity does not countervail the discommodity:"

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* Court and Times of Charles I., vol. ii. p. 147.

and Hooker writes, "They knew that howsoever men may seek their own commodity, yet if this were done with injury unto others, it was not to be suffered." Peter Wentworth, in one of his speeches in Parliament during the reign of Elizabeth, is reported to have said, "I do think it expedient to open the commodities that grow to the Prince and the whole State by free speech used in this place."

The word *parts* seems to be undergoing a restriction in meaning at the present moment, or rather, has been undergoing it during the last fifty years. A century ago it was used in the plural, to denote genius or talents. A man of genius was called a man of parts. Horace Walpole makes frequent use of the phrase. In a letter to Mason, speaking of Goldsmith in a way which shows he was not able to appreciate that admirable writer, he says, "Dr. Goldsmith was an idiot, with once or twice a fit of parts." Another way in which it was frequently employed in the plural was, to denote districts or countries, as in the expression, "He travelled in foreign parts." These modes of employing the noun in the plural are not yet obsolete, but they are infrequent, their place being supplied by more precise expressions.

We have another remarkable instance of a similar change in the word *wit*. At first it signified the mental powers collectively, and was used as we use the word intellect or understanding.

"See you not," says Sir Philip Sydney, in his "Arcadia," "the rest of these beautiful flowers, each of which would require a man's wit to know, and his life to express." Another old writer says, "Will puts in practice what the wit deviseth." In Minshem's Dictionary, 1627, there are no such words as genius or talent; wit is the only term used for mental power.*

It was afterwards employed very loosely, sometimes to denote quickness of apprehension, sometimes beauty or elegance in composition, sometimes as a designation of men of talents or genius. "The definition of wit," says Dryden, "is only this, that it is a propriety of thoughts and words; or, in other terms, thoughts and words elegantly adapted to the subject."

So Pope,

> "True Wit is nature to advantage dress'd,
> What oft was thought, but ne'er so well express'd."

Dryden, however, is very inconstant in the employment of the word, and Pope, too, uses it in the most various acceptations. This is particularly remarkable in his "Essay on Criticism," where he brings it in as a rhyme at least a dozen times, besides freely sprinkling it in the body of his verses, so that the recurrence of the term becomes a blot in the composition.

In the present day all other meanings are fast disappearing before one. The word is now almost exclusively employed to designate an ingenious and unexpected combination of ideas; and I think the dropping away of the other senses, formerly attached to it, has proceeded from causes not difficult to assign.

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* This is given on the authority of Sir James Mackintosh. See Memoirs by his Son, vol. ii. p. 45.

Such changes as these arise, in fact, from a progress in accuracy of thinking, which necessarily manifests itself by a greater precision in the use of words. Wherever there is a term signifying, loosely and indiscriminately, several ideas which ought to be distinguished, there will be usually found other terms used synonymously or interchangeably with it; and when it becomes restricted to a narrower and more determinate signification, the accuracy of thought which has led to such a limitation will inevitably extend to the synonymous words. To these will naturally be assigned the discarded acceptations; and this process, if I mistake not, may be actually seen to have taken place in our own language.

A century or two ago we appear to have had a number of words rather vaguely designating the same thing, with slight shades of difference, perhaps, but not sufficient to prevent the words from being used for each other without much discrimination.

As knowledge became more accurate, and ideas in some confusion became more distinct, requiring gerater precision of language, these vague synonymous terms appear to have been severally taken up by the disentangled ideas, as they separated themselves from each other, each idea appropriating one to itself. Thus *judgment*, *understanding*, *cunning*, *wit*, *intellect*, *intelligence*, *wisdom*, some of which were often used interchangeably (because, in fact, the ideas for which they now stand were not then distinctly separated in general apprehension), have, in the lapse of ages, paired off, if I may so express it, each with a particular notion most suitable to it.

Perhaps the most remarkable instance of separation and appropriation of this kind, amongst the words here enumerated, is furnished by the substantive *cunning*, which is now exclusively applied to a certain crafty artfulness, whereas, anciently, its usual signification was wisdom or knowledge, and sometimes skill.

A writer in the time of Henry the Fifth says (without intending the slightest irreverence), " The three Persons of the Trinity are of equal cunning." Sir Philip Sydney uses it in a similar sense, in a passage where he tells us that "the uttermost cunning of Nature is employed in man;" while his contemporary, Lord Bacon, adopts what is now the only acceptation, when he writes, "We take cunning for a sinister or crooked wisdom." Locke, at a later period, calls it " the ape of wisdom."

Such changes in meaning, as those which I have noticed, have manifestly arisen from the natural procedure of the human understanding, continually endeavouring to find expressions, not only to designate new objects, but to mark new or more clearly discerned distinctions amongst objects and qualities already known.

It is not to be supposed, however, that all changes in meaning are regular, and follow only as consequences of improved knowledge and juster discrimination. Some are irregular, and instead of exhibiting a tendency in language to clear itself of synonymes, and to become more definite and precise, seem to show something like the reverse.

There is now, for example, a common employment of the word *nice*, in the sense of pleasing or agreeable, against all purity and precision. Good writers and speakers do not, of course, use it in this acceptation. In correct language, a *nice* girl is a fastidious girl, not an agreeable one; and if she rides a nice horse, the animal must be somewhat choice or dainty in the kind of food he deigns to swallow.

This employment of the epithet in an objective sense, although a departure from precision, is not casual or arbitrary, but appears to be dependent on another principle of the mind. It is a common mental process to transfer a quality of the agent to the object on which it is exercised; the nicety of the man in selection is ascribed to the things selected: a nice distinction is a distinction nicely drawn; a nice object is one that pleases a nice taste. Thus it is that words slide into an acceptation, which is called improper at the outset, but which may ultimately become established by custom, and claim to be correct.

We shall find, if I mistake not, an analogous lapse from a subjective to an objective signification in the corresponding Latin word *elegans*. Its primary sense, derived from the non-extant verb *elego*, *I pick out* or *choose*, is *nice* or *choice*, which is manifest in such phrases as "elegans formarum spectator," and from which it appears to have glided into an objective signification, analogous to that of the English epithet *elegant*, as in the expression "elegans oratio." *

A transition like this, in two different words, in two different languages, indicates a common principle of change. It is worthy of remark that the converse seems occasionally to take place. One of the words I have used above, viz., *choice*, had originally an objective meaning, accordant with its derivation from the French *choisi*. Thus Howel, in his "Familiar Letters," A.D. 1621, speaks of "choice flowers and fruits," and "a choice pattern to build by;" while Jeremy Taylor, rather later, employing the word in a subjective sense, says,

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* Dr. Freund, in his Latin Lexicon, divides the meanings of *elegans* into two classes, those relating to persons and those relating to things: some of the former are objective, but the greater part subjective; all the latter are necessarily objective.

"He that is choice of his time will be also choice of his company."

The epithet *dainty* is also employed in both ways, but whether the objective or the subjective acceptation had the priority, I am not able to say. Shakespear uses it indiscriminately in both senses.

It may be remarked generally, in reference to transitions in the signification of words, that the transfer of an epithet from a case where it is strictly applicable to other allied cases, where it is less so or erroneously deemed applicable, and thence to other cases with similar divergence, till sometimes the primitive meaning is wholly superseded, is not confined to the interaction of objective and subjective meanings, but is caused by various other analogies, and seems to have extensively prevailed in other languages as well as our own.

Nor are words which have acquired in this way a sense not in accordance with their origin to be rejected in their new acceptations, if they have established themselves in the general favour of intelligent speakers and writers. It is only in the transition period that purity of style requires them to be shunned. Words are not to be tied down for ever to their primitive significations either in style or in philosophy; and the contrary doctrine is refuted by the very extravagant results to which it was pushed by its able advocate, Horne Tooke.

There are other changes in signification which are to be ascribed to the circumstance of words losing in process of time, from constant use, their metaphorical character. This happens remarkably in words denoting mental qualities and operations. As examples of the general principle, not in elucidation of mutations in English phraseology, I may cite the words *imagination*, *inspiration*, *recollection*, *deliberation*, *sagacity*, all of which, as is manifest from their derivation, were originally terms denoting physical or sensuous operations or properties, and were applied metaphorically to the mind, but have now come to signify directly what they before expressed figuratively; that is to say, when we use *sagacity*, we no longer think of quickness of smell, and of the analogy between it and a quality of the intellect, but we think directly and solely of the quality of the intellect, although we occasionally meet with such lines as,

> " The hound sagacious of the tainted prey."

So much for the general principle, operating in all languages, to strip metaphorical phrases of their figurative import. As an instance of its operation in the case of English words, I may adduce the monosyllable *puff*, formerly signifying (if lexicographers are to be credited) nothing but "a small blast of wind," and only recently used to designate an act of inflation *not* small, to which the term seems now almost exclusively applied without a sensible metaphor.

Another example coming under this division of my subject is supplied by the term *speculation*, which has undergone a singular fate. Applied in the first instance to the organ of vision [*], it was thence metaphorically transferred to the mind, in the way already described, and was gradually exalted to the dignity of designating, without a metaphor, the theories and meditations of philosophers. Alas! for its subsequent degradation! From the domain of philosophy it has migrated to the offices of stock-jobbers and share-brokers, and in one or other of the memorable *crises* marking the last quarter of a century (especially that of 1845) most Englishmen have been too thoroughly initiated into its modern signification to forget it with facility or remember it with pleasure.

This part of the subject alone would present sufficient matter for a separate essay.

The principles which I have hitherto attempted to explain as governing the changes in language may have been—many of them, at least, and possibly most of them—recognised by one or other of those who have written on the philosophy of language: but there is one other influential circumstance, never, I believe, hitherto noticed, which, I am satisfied, has considerable power in modifying the acceptation of words—I mean similarity of sound between words which are not related by derivation. It will, perhaps, be difficult to convey to others in a convincing form the grounds on which I have come to this conclusion, because they not only are in their nature conjectural, but consist of subtile relations, to be apprehended rather than explained. My theory, however, is this, that words sometimes contract a meaning from their resemblance in sound to other words with which they have really no connection but the similarity of the impressions they make on the ear. Thus, if I am not mistaken, the word *defalcation*—used at present in a very vague and unsettled manner — sometimes borrows a meaning from the verb *fall away*, and at other times from the noun *defaulter*. When the public revenue falls short of what it was before, our newspaper writers tell us of a *defalcation* of the revenue; and, in a number of the "Morning Chronicle," which I have just taken up, there is a paragraph headed "Defalcation at the Manchester Infirmary," the burthen of which is, that a clerk in that establishment had appropriated some of its funds to his own use.

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[*] "Thou hast no speculation in those eyes."—*Shakespear*.

Here we have obviously two widely different acceptations of the same word.

The original and proper meaning of defalcation (derived from the Latin *falx*, a sickle, scythe, or other hooked cutting instrument) is a cutting off or down, a pruning or retrenchment. Thus it is a right use of the term to say, with Addison, "The tea-table is set forth with its usual bill of fare, and without any defalcation" *i. e.* without any thing being cut off or retrenched. If any one were to inform us that Parliament had not granted the supplies without a considerable defalcation, his phraseology would be correct; but it would be incorrect to say (as is often said) that the quarter's account exhibits a defalcation of the revenue, as it would be to say that it exhibits a retrenchment of the revenue. Defalcation expresses the act of an agent upon an object, whereas, by this phraseology, applied to the revenue, it is intended to convey, not the action of an agent upon it, but a decrease in the amount of the revenue, irrespective of the cause—a falling off.

In this illegitimate sense it is employed, if I mistake not, by Horace Walpole, when he says, "A very considerable defalcation from the standing majority had been expected."

I think it not improbable that the use of the term, in what may be called a neuter signification, has originated in the phonic resemblance of its second syllable to the word fall, which, being tacitly combined with the prefix *de* (away from, off, or down), makes up the meaning (after a hybrid fashion, it is true) of *falling away* or *off;* a meaning not precisely expressed, as far as I know, by any single term in the English language, except it is the unemployed nouns, decidence and decadency.

In accounting for the other use of this word exemplified in the extract given from the "Morning Chronicle," I feel on surer ground, and have little doubt that a meaning has been reflected upon it from the word *defaulter*. When a man entrusted with funds by his employer uses the money clandestinely for his own purposes, he is said to be a *defaulter*, and by many writers and speakers in the present day the circumstance would be very incorrectly styled a *defalcation* on his part, as if the two words had sprung from a common root. This incorrect use of the term, like the other, has apparently arisen from similarity in sound: in no other way, at least, can I account for the word defalcation being employed to designate the act of a defaulter, the two terms not having the slightest etymological relationship. That the former *is* used to express the act of the party designated by the latter, is decisively proved by such passages — numerous enough in the publications of the day — as the following, which is a literal extract from a newspaper in February, 1850. "The *defalcation* of Mr. Murray, the Secretary to the Ecclesiastical Commissioners, has led to a very pretty exposé in the House of Commons." . . . "We find him, after dabbling in railway shares to the extent of 580,000*l.*, leaving the country a *defaulter* to the tune of eight or ten thousand pounds." *

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* In a letter written in the reign of the first Charles, the word expressive of the act appears to have been correctly used, although the passage is mutilated just at the most important point of the sentence. "The wine-customers, as it is said, will

My next instance to show this reflexion of meaning from one word to another is equally striking. The words *relevant* and *irrelevant* may be adduced as, in every way, remarkable examples of rapid mutations in language. The use of these terms, in the sense they now bear, is quite modern; and yet he would be considered a great purist who should refuse to employ them. Dr. Johnson has one of them, *relevant*, but he gives only one acceptation—*relieving;* quotes no example, and refers to no authority but the French Dictionary. Other lexicographers agree that this is the original sense, and explain it further by the epithet *assisting.* I find it used in this acceptation in Ireland as late as the year 1762. Chief Justice Aston, in a letter to Mr. Secretary Hamilton, dated Dublin, June 24, in that year, writes, in reference to an outrage, "It ever turned out to be the result of some local dissatisfaction, which these miserable delinquents affected to act upon by way of redress, though they ever pursued vindictive rather than relevant measures;" * which is tantamount to saying, that they pursued measures of revenge rather than measures of relief or redress.

Relieving or assisting, however, is not the sense

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petition the king for a defalcation of their yearly . . . (sic in orig.), or otherwise they are not able to hold them."—The Court and Times of Charles I. illustrated, vol. ii. p. 232.

* Correspondence of Burke, edited by Lord Fitzwilliam, vol. i. p. 38.

in which relevant is now used. It is employed universally in some such way as the following: "What the speaker is now saying is not *relevant* to the question;" or, "His arguments are *irrelevant* to the subject." Now if we construe the terms in the sense of *assisting* or *unassisting*, these propositions are not destitute of a meaning, but it is a meaning which only approaches what is intended to be conveyed. The intention is to affirm that the arguments do not *relate* to the subject, are foreign to it, are *irrelative:* and if the idea of lending assistance is at all implied, it is subordinately. How, then, shall we account for so remarkable a transition in signification,—so effectually accomplished, too, almost within our own recollection. I see no other explanation than that which is furnished by the theory already stated. A colour of meaning seems to have been reflected on the word *relevant*, from the word *relative*, merely in consequence of a similarity of sound, without the slightest etymological connection; and the result has been, that, in using the former, we have a notion in our minds compounded of the two ideas of assisting and relating to—principally the latter.

Since writing these remarks, I have found *relevant* used by a Scotch author, as far back as 1707, in the sense of valid.* Referring to an opinion of

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* A Brief Discourse concerning the Second Sight, by the Rev. Mr. John Fraser, quoted by Dugald Stewart, Philos. Essays, p. 576.

Cardanus, he says, "It seems truly to be founded on relevant grounds." Moreover, the term appears to have been regularly employed in the Scottish courts, in relation to indictments, as in the following expressions: "The Lords Commissioners of Justice find the libel relevant to infer the pains of law:" and "Let the relevancy of the indictment be determined:" and in Bell's Dictionary of the Law of Scotland the substantive relevancy is defined, "The justice and sufficiency of the matters stated in the indictment to warrant a decree in the terms asked." *

Walker, in the first edition of his Pronouncing Dictionary, spoke of this word as a new coinage of the House of Commons, but was subsequently informed by Mr. Elphinstone that it had long been a jurisprudential word in Scotland, and had been transferred from the Scotch bar to the British Parliament.

Supposing the term to have set out from the acceptation in which it was employed by the Scottish courts, there is the same difficulty in accounting for its transition to its present sense as in the other case, and my theory will equally apply. That the present signification of the word is not *just and sufficient*, is obvious. We might say with great propriety of a speaker or writer, "His arguments are not irrelevant to the question, but they are far from being just and sufficient."

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* Blackwood's Mag., May, 1851, p. 606.

The adoption of these two words, *relevant* and *irrelevant*, seems to have in some degree thrown out of use two others which were formerly employed to express analogous qualities,—I mean *pertinent* and *impertinent*. *Pertinent*, indeed, still maintains its ground with good writers; it is clear and precise, and preferable to *relevant* in many, if not in all, the cases where the latter is commonly employed. Take an example from Bacon: "I set down," says he, "out of experience in business and conversation in books, what I thought pertinent to this business." Most modern writers would have here said *relevant*. The negative *impertinent* was once similarly used. "The contemplation of things," says Tillotson, "that are impertinent to us, and do not concern us, is but a more specious idleness."

But this latter word is now seldom employed to signify *not pertinent*. It seems insensibly to have acquired a different import, to have lapsed successively through the several meanings — *not belonging to the matter in hand, having no business with the matter, intrusive, meddling, unmannerly, insolent*. Although the transition from one of these senses to the next seems easy, yet between the first and the last there is so wide a difference, that I am tempted to suspect even here the influence of similarity in sound, and that the word *impertinent* has had a colour of meaning reflected upon it from the epithet *pert*. It may be asked, indeed, how it is, if the former has caught a reflex meaning from the latter, that the word *pertinent*, still more closely resembling the monosyllable in the totality of the impression which it makes on the ear, has not done the same? This would be, in truth, a fatal objection, unless the theory could account for it. The fact is, however, that it points to a principle requisite to complete the theory, namely, that this reflection of meaning from words of similar sound, but unconnected by their etymological origin, is necessarily confined to words not repugnant to each other in signification, but expressive of notions capable of coalescing. The epithets *pert* and *pertinent* obviously designate qualities without any affinity, and even somewhat repugnant, while *pert* and *impertinent* denote (as every one knows to his cost) such as may be readily united. It is only with words in the latter predicament that we can expect similarity in sound to have any influence.

It is not unlikely that this hypothesis respecting the influence of similarity in sound may appear to others altogether fanciful, and it certainly admits of nothing beyond presumptive proof. The other day, however, in taking up a number of a popular periodical work, I was gratified to discover that something akin to it had occurred to the mind of another person, although his hypothesis is not identically the same. It is stated in different terms and with different exemplifications. The two speculations, nevertheless, agree in considering that a meaning is sometimes reflected from one word to another in consequence of similarity in sound, when no etymological relationship exists between them.

The writer remarks that analogy in language produces a twofold disorder: "First, we gradually wear a word into the resemblance of another, if that other is associated with it in our minds by some mutual property in meaning. Secondly, we gradually contract new shades of meaning in the use of a word, approximating it to another, if that other is associated with it by some mutual property in sound." As random illustrations, he gives the word *bumper*, which he says receives an addition to its expressiveness from *bump* and *bumping;* also *slime*, *slide*, *sly*, *slink*, *crash*, *crush*, *gash*, *gush*, *rush*, &c. &c." "All these, by their correspondence, receive a certain force of meaning beyond the control of their etymologies." *

But I feel that I have now dwelt upon the subject at sufficient length. It is time to sum up the views contained in this Essay. After having, at the outset, classed such changes of language as I purposed to treat of, under the several heads of the introduction of new words, the formation of new compounds, the abandonment of old words, and changes in the meaning of words still retained, I have endeavoured to show, first, that the introduction of new words necessarily results from the progress of knowledge and the efforts of the human mind to find commensurate expressions: secondly, that new combinations of existing words proceed, partly from the same cause, and partly from the desire to escape circumlocution: thirdly, that the disuse of old words may be accounted for by the disappearance of the objects and cessation of the acts they formerly denoted, also by the propensity of mankind to drop useless synonymes, to shun phrases debased by low and indelicate associations, and to disembarrass themselves of such words as are identical in sound although different in signification: fourthly, that changes in the senses of words still in use are some of them simply limitations of meaning, the result of greater accuracy in thinking, and of the consequent effort after greater precision of language, which have led to the appropriation of terms before used loosely and interchangeably to distinct ideas or shades of thought; while other changes may be referred to unconscious trespasses on precision in the transference of terms from subjective to objective acceptations, and from proper uses to analogous cases where they do not strictly apply; others to the transition of words from a metaphorical to a literal sense; and others to the influence of similarity in sound amongst words not related by derivation.

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* Some of the words cited by this writer are, however, evidently related by derivation.

To a Literary and Philosophical Society there is no need, I hope, to offer an apology for the introduction of a subject in which, if any where, literature and philosophy unite, and in which they are almost equally interested. As a matter of taste, such mutations in language as I have been engaged in tracing are full of interest to the cultivator of polite letters: as a matter of moral speculation, exhibiting as they do the operation of the faculties and propensities of human nature and the progress of knowledge, they are equally interesting to the philosopher. In another respect, all investigation into causes which influence the structure and copiousness of language, and the meaning of terms, is still more important, as it directly assists to improve the great instrument of reasoning and communication itself. A knowledge of the causes of change tends to prevent all but legitimate and useful changes; and by fixing the attention on the acceptation in which words are to be employed, it gives precision to language and accuracy to thought.

I may add, that of all the languages in the world none is more worthy of investigation than our own, which, as it at present exists, may be characterised as full, rich, vigorous, and expressive; and every Englishman with the slightest tincture of literature must feel interested in tracing the course by which it has reached its actual condition.

DISCOURSE IV.

ON THE SCIENCE OF POLITICAL ECONOMY.

The design of the discourse which I have undertaken to deliver this evening is to show the object and utility of a science which has latterly attracted great attention and some obloquy. Much, however, as it has been brought into public view, the general conception of its scope and usefulness seems unsteady and imperfect, if not erroneous.

It may be described in general terms as the science which treats of the nature and causes of the *wealth* of nations; or better, perhaps, as the science which treats of the *economical condition* of nations, and the circumstances which affect it; that is to say, their condition in respect of the necessaries, comforts, and luxuries of life.

Even this description may be considered as somewhat vague, and, to those who have never bestowed any attention on the subject, would not convey any definite notion of the science; but it appears to me preferable to the definitions which have been substituted for it.

Let us turn for a moment to the definitions usually given. One class of writers tell us that

Political Economy is to the state what Domestic Economy is to a family. This seems wide of the mark. A family receives in some way or other a certain income, which it has to expend; and its economy, according to the meaning usually attached to the term, consists in the disposal of it. If there is any thing in a state analogous to this, it is the management of the state-revenue — the fiscal or financial department; but this is evidently not the meaning of the definition. The parallel is intended to be drawn between a family and the community. In what points, however, they are meant to be compared, it is not easy to see, as the economy of a community, if it does mean the management of the public revenues, must be the aggregate of the economy of single families, since there is no separate entity called a community which acquires and expends a revenue. If, in these strictures, I have misconceived the purport of the definition, this very misconception would be a presumptive proof that the definition has not accomplished its proper object, that it has thrown no light on the matter which it attempts to explain.

Again, we are told that Political Economy treats of the laws which regulate the production, distribution, and consumption of wealth or commodities. This may appear, at first sight, precise enough; but let us examine it. What is meant by a law which regulates the production of a commodity? By a law, in this use of the term, is meant a general fact, or a fact which is true of a class of objects. Agreeably to this sense, it is a law which regulates the production of wheat, that the seed of the plant must be sown in the earth; and it is a law which regulates the production of potatoes, that it is necessary to sow only the tubercles of the root. But these laws, according to which the production of wheat and potatoes are regulated, do not certainly come within the province of Political Economy. In the same way, were it needful to encumber the subject with details, it might be shown that the production of cloth is governed by certain mechanical and chemical laws, the investigation of which has certainly nothing to do with the science now in question.

Similar objections may be brought, and even with greater force, against the expression that Political Economy treats of the sources of national wealth, when this expression is employed to define the province of this science. An author who treats of mines, fisheries, and agriculture, treats of the sources of national wealth, yet he may do it without at all touching on Political Economy.

It is stated by one writer of no mean acuteness and clearness of intellect, "That the end and object of this branch of knowledge is to show in what manner, and by what means, the physical gratification of human wants can be most effectually distributed amongst all classes:" a description that would obviously comprehend the science of the engineer who should point out the efficiency of canals, steam-boats, rail-roads, and steam-carriages, in distributing enjoyments through the community.

All these definitions and descriptions are too unqualified; they describe the end and business of the science without the proper limitation. The object of Political Economy is not to ascertain all the laws by which wealth is produced and distributed, but only one class of them, namely, the moral or mental laws, or, in other words, those laws of human nature on which the economical condition of nations depends. It has nothing to do with investigating the comparative merits of systems of husbandry, or of road-making, or the superiority of one machine for making cloth over another—circumstances which may greatly affect the production and distribution of wealth, yet do not enter at all, or only incidentally, into the inquiries of this science. While these circumstances would fall respectively within the province of the agriculturist, the engineer, and the manufacturer, the political economist would be concerned only with investigating the motives or the principles of human nature which are brought into play in all these cases, together with their effects on the wealth of the community. It would be his province, for example, to inquire, in relation to such matters, whether men, if left to the natural desire of bettering their condition without any interference, would find out and adopt the best modes of cultivating the soil, manufacturing cloth, and making roads; or whether these objects would be most effectually attained by directing their efforts through the means of restriction on the one hand and encouragement on the other. He would trace the motives operating in each case, and the effects resulting to the economical condition of society. When Adam Smith showed the benefit of the division of employment, by the instance of the pin-maker, he was engaged in pointing out the motives which led to such a division, and the effect of it on the labourer's skill and condition.

Let us take for illustration any of the great questions which have raised the science of Political Economy into so much importance, and we shall find them occupied almost altogether with the consideration of the motives by which men are actuated, and the effects resulting from these motives on the condition of the community.*

The question of the depreciation of the currency during the existence of an inconvertible paper money will do as well as any other for the purpose of elucidation. Every body now agrees, that if an extraordinary quantity of such paper be issued the prices of commodities must rise; that all the coin in circulation of the same denomination as the paper will disappear; that bullion will rise with other articles, and that the foreign exchanges will fall. The consequences of these changes to various classes of the community will be important; the persons who are in debt, or who hold stocks of goods, or estates in houses and land, will be great gainers, while creditors and annuitants, and other possessors of fixed incomes, will lose.

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* This view of the foundation of Political Economy is explained at greater length in the Author's Essay on "The Uniformity of Causation," published in 1829.

If this representation of the matter be closely examined, we shall find that it consists of two parts—the one containing a statement of certain events which are the consequence of a superabundance of inconvertible paper money, all which events are, in fact, composed of the voluntary actions of men; the other part containing a statement of the effects of these events on the wealth of the various classes of the community.

This rise of prices, in consequence of the over-issue of paper money, is one of those laws which it is said to be the business of Political Economy to treat of. On tracing the mode in which the over-issue produces the effect, we find it is this—the greater plenty of money in the hands of individuals incites them to become more extensive purchasers in the market; but as there is no simultaneous increase of the commodities demanded, the holders of them take advantage of the increased demand and exact a higher price. It is needless to go beyond this first step. The law in question, it thus appears, is a law relating to the voluntary actions of men, or, in different words, it is expressive of the operation of certain motives on the human mind. The same will be found to hold true of the other events enumerated, such as the disappearance of coin and the fall of the exchanges. We may therefore describe the science of Political Economy as an enquiry into the operation of those principles of human nature on which the economical condition of a community depends.

With the same view of showing the nature and scope of this science, it will be useful to discriminate it from another, with which it is intimately connected. It has been said that there has not yet been a clear line drawn between the sciences of Politics and Political Economy; that their separate provinces have not yet been distinctly discriminated; that we yet want a plain account at what points they touch, and where they stand apart; and that this want is an opprobrium to both sciences. In my own multifarious reading on this subject, I must acknowledge that I have vainly sought for a satisfactory account of this kind.*

Perhaps the time is come when an attempt to furnish it may be made with some hope of success; at all events, such an attempt can scarcely be without profit.

The science of Politics may be defined as that which treats of the subject of Government in all its relations. In another treatise†, I have already endeavoured to show the province of Government to be the promotion of the welfare of the community by such measures as individuals or subordinate associations cannot advantageously carry into effect, or perhaps cannot carry into effect at all. What these measures are, it is the business of political science to determine. The welfare of a community is dependent on its health, its morality, its intelligence, the amount and distribution of its property, its form of government, its laws, and the state of its relations with other countries. The science of Politics has, therefore, to investigate all these sources of good and evil, to ascertain how far any of them are to be left to the operation of private interests, and in cases where the interposition of the supreme authority is necessary, to determine the extent and mode of interference.

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* This was written in 1835. The defect has doubtless been since supplied.

† The Rationale of Political Representation.

All this implies a wide range of knowledge. In order, for instance, to determine how far the health of a community should become the object of regulation by the state, the politician must possess some acquaintance with the science of medicine, that is, with the circumstances on which health and disease depend. There may be causes of disease which individual efforts cannot prevent or remove, but which may be readily obviated by the supreme power,—such causes, for example, as unrestrained intercourse with countries afflicted with contagious disorders, or the existence of extensive marshes, which can be drained only by the appropriation of part of the public revenue. To a certain extent, therefore, the statesman must possess a knowledge of the science of medicine; and, at all events, he must understand it so far as to be able to avail himself beneficially of the auxiliary knowledge of professed adepts. In the same way, a knowledge of the philosophy of the human mind is requisite in order to determine the best measures for promoting the welfare of the community by increasing its morality and intelligence. The first object, which includes, in fact, all penal legislation, cannot be at all accomplished without understanding the influence of motives, and the nature of the pleasures and pains to which human nature is subject. Accordingly we find that by far the profoundest work on legislation which has ever been given to the world enters upon an elaborate preliminary inquiry into this department of philosophy, besides discussing the foundation of morals and the principles of reasoning.

A legislator, to be worthy of the name, must possess a considerable share of this species of knowledge; and he would be still better fitted for his office if his knowledge, instead of being acquired by casual opportunities, and by desultory efforts, and being without method and order, had been the result of a thorough initiation into the science of the human mind. The supreme authority of a country cannot, in the nature of the case, have much to do with regulating the causes of health and disease; and therefore a statesman may dispense with a knowledge of medicine beyond that portion which a well-educated man can scarcely help acquiring: but the whole business of government is to act on the human mind, and it is therefore absolutely essential for achieving the greatest public good that he who is placed at the head of affairs should fully understand the principles of his own nature, or at least be on a level in this respect with the philosophers of the age.

The considerations which have been adduced show two truths: first, that the science of politics has a certain definite province, namely, to investigate the objects of government, and the means of carrying those objects into effect; and yet, secondly, that in the prosecution of its purpose it requires the assistance of other sciences. No one, however, ever considered that on this account there was any difficulty in discriminating it from these other departments of knowledge. It has never been confounded with medicine, because it has sometimes had to treat of regulations affecting the health of the community; nor with the philosophy of the human mind, because it requires for its purposes much of the knowledge embraced by that science. Medicine and the philosophy of the human mind have their own range independent of politics, and unaffected by the use which the latter may make of their principles, or by any coincidence in their inquiries; each of them embracing a variety of conclusions which have no relation at all to the science of government.

These remarks will prepare us for the distinction between the science of Politics and that of Political Economy. There is just the same sort of difference between them that there is between politics and the philosophy of the human mind, and just the same sort of relation.

A knowledge of the human mind is requisite in Politics, because all the proceedings of government are necessarily addressed to the motives and capacities of human beings, and are, or ought to be, intended for their welfare; and a knowledge of Political Economy is requisite, because the administration of public affairs necessarily affects the industry and wealth of the community. The legislator must understand not only the motives which actuate mankind in social intercourse, so as to be able to make his laws efficacious in maintaining rights, adjusting conflicting claims, and suppressing offences, but also the circumstances which increase or diminish the prosperity of a country in its agriculture, commerce, and manufactures; and how far these circumstances can be created or removed by the influence of the supreme power of the state.

Thus the statesman, whose business it is to ascertain by what measures the public welfare can be promoted, must possess an acquaintance with the science which treats of the wealth of the community, as well as with the sciences which treat of the human mind and the human body. But the circumstance of having to avail himself of the knowledge supplied by this science, or (if any one prefer having the matter stated differently) the circumstance of the investigations belonging to his own particular science of Politics running in the same track with some of the investigations belonging to Political Economy, does not render these two sciences identical. The same sort of intermixture of principles, or, rather, the same sort of mutual assistance, occurs in the physical sciences. It is known to all that the science of Geology requires the aid of Chemistry, Botany, Zoology, and Mineralogy: in other words, in order to prosecute successfully the inquiries peculiarly belonging to it, the geologist must have a knowledge of many things in these other departments of investigation. And as these departments have many facts and principles which cannot be of any service to the geologist as such, which are not susceptible of application to his own pursuit, so the science of Political Economy may contain facts and principles which can have no practical relation to the science of Government.

At the same time every one must see that, as a great number of political regulations have a direct bearing on the industry and wealth of a country, a man can scarcely be a good politician without being a thorough political economist. If as great a number of political regulations related to the health of the community, a good politician would be under the necessity of being also an adept in medicine.

There is one circumstance which would alone render the study of Political Economy indispensable to the statesman, if there were no other connection between the administration of public affairs and the wealth of the people,—and that is, the necessity of raising a revenue for the purposes of the state. How particular modes of taxation affect industry and capital must be understood in order to determine which of them should be resorted to, and can be properly understood only by one who is master of the whole science to which such investigations belong.

Nothing, perhaps, will more clearly show the relation which the science and art of Politics bear to other departments of knowledge, and more especially to Political Economy, than to select a particular instance in which the statesman is called upon to weigh some measure of public policy, on considerations belonging to such different departments. Suppose, for example, that he is deliberating about imposing a duty on spirituous liquors. The questions which will naturally suggest themselves will relate to the disturbance produced by such a tax on the employment of capital and labour, the encouragement afforded to smuggling, the productiveness of the tax to the revenue, and the advantage to public health and morals of checking the consumption of an intoxicating and pernicious beverage.

The doctrines of Political Economy show that it is rarely advantageous to the wealth of the community to alter the spontaneous application of its industry and capital, and also that, whenever the duty on any article is high enough to cover the risk of a contraband trade, smuggling will inevitably take place. So far, therefore, there is evil in the proposed measure: but this is only one part of that comprehensive view of the question which the statesman has to take. If, by taxing the article, he can raise the revenue which he requires in a ready manner, and without much expense in collecting it, the economical disadvantage which more or less attends all taxes must be submitted to; and if (what is still more important) he can, by such a duty, lessen the practice of drinking ardent spirits amongst the people, and thus rescue them from the disease and misery consequent on this pernicious habit, the mere disturbance in the employment of industry can hardly be considered as entitled to any weight. So great, indeed, would be the benefit which society would derive from the discouragement of spirit-drinking, that the statesman would be justified in imposing a duty with this view alone, and placing it at a height which would operate as a prohibition, were not the dictates of morality and of medical science here met by the truth taught by Political Economy, and already adverted to, namely, that the desire of profit would inevitably and instantly lead to a contraband traffic, and all the moral evils of smuggling would be introduced, along with those other evils which it would be the object of the duty to prevent. Some striking instances of these results have occurred in our own country. Thus, in the determination of this one question, the statesman would have to take into view considerations belonging to the economical condition, the health, and the morals of the community, as well as to the supply of the public treasury; and he would do this without any danger of the several departments of knowledge to which these considerations are usually referred being identified by himself or others with the science of Government. The former sciences, when thus employed, may be regarded as subsidiary to the latter. Every science, in its turn, is liable to become subsidiary to other sciences.

These explanations of the object of the science, and the relation and distinction between it and politics, will almost, I trust, supersede the necessity of insisting on its utility. That it must be useful for a government to understand the effects of political measures, laws, and institutions on the economical condition of the people, to know whether its proceedings depreciate their property, interrupt their pursuits, deprive them of their means of subsistence, or, on the contrary, animate their industry and raise their condition, seems too plain a proposition to be denied: that it must, also, be useful for the people themselves to understand the causes on which their prosperity depends, to know what the state can do to assist that prosperity, and what it cannot, and to be fully instructed that there are certain evils which can be avoided, and certain advantages which can be obtained, by nothing but their private prudence, seems equally plain. And it is really amazing, if any thing in human folly could amaze us, that it should ever have entered into the conception of any man to regard this science, not only as useless, but as pernicious, and to declaim against it as a sort of poisonous plant, to be uprooted and destroyed. The utility of a science may be viewed in two aspects—as enabling us to avoid evils, and as enabling us to secure benefits. Ignorance does not simply deprive us of advantages; it leads us to work our own misery: it is not merely a vacuum, void of knowledge, but a *plenum* of positive errors, continually productive of unhappiness. This remark was never more apposite than in the case of Political Economy. The low state of this science till within the last thirty or forty years was marked by the prevalence of the most pernicious principles—principles which stifled in the birth prosperity and enterprise ready to start into life and vigour, as well as inflicted positive calamity. As one instance of the vast evils of error on this subject, I will call to your recollection the effects produced by the prevalence of what is called the mercantile theory, or, in other words, the opinion once firmly rooted in every mind, that wealth consists in the abundance of gold and silver, and may be indefinitely increased by forcing their importation and preventing their exportation. "This false theory," says Mr. Senior, "has occasioned, and still occasions, more vice, misery, and war than all other errors put together." Without conceding a supremacy in mischief to this gross misconception (for other errors might be adduced still more mischievous), I think no one will deny the bad effects of it who looks even at the career of Spain alone—whose stringent laws to prevent the exportation of gold and silver, and other absurd restrictions on her foreign and colonial commerce, instead of helping to save her from sinking to the condition of one of the poorest countries in Europe, were some of the main causes of her degradation.

If I were called upon to select another instance of the mischiefs flowing from ignorance of the truths of Political Economy, I should cite the question of paper money. Errors on this subject —errors committed by statesmen when the simple truth was before them in the writings of political economists—errors, the consequence of neglecting this science—have consigned thousands to misery even in the lifetime of many who hear me.

In truth, the question as to the utility of the science of Political Economy comes to this. There are a great number of important points to be determined as to the operation of various circumstances on the economical condition of the people, in order to guide the steps of private individuals and the measures of statesmen to the most beneficial results, — such points, for example, as the effects of restrictions on trade, of a compulsory support of the poor, of an increase or decrease of the currency, of machinery for superseding manual labour, of regulations to force the home growth of an adequate supply of corn, of various kinds of taxes, or what has been technically called the incidence of taxation; all which questions involve a hundred other subordinate inquiries of almost equal importance to the principal ones.

Now all these important points must be considered and determined some way or other, or the statesman must legislate and act at random without any foresight of the effect of his own measures on national wealth and national happiness. There are two ways in which the questions may be treated: 1st, they may be treated casually, that is to say, each point, as it presents itself for determination in the course of events, may be considered, by an extemporaneous application of mind on the part of the statesman, on its own isolated ground, without attention to any thing but the peculiarities of the case and the time, and without any object but to secure an immediate benefit or remove a pressing grievance; or, 2dly, such questions may be treated systematically and on principle, that is to say, they may be determined by a regular investigation of the principles on which they depend, by a copious induction of facts, by a comprehensive survey of the relation which they bear to other questions, by a rigorous deduction and comparison of all the consequences, immediate and remote, of the several courses of action which the questions may bring into view: in a word, they may be determined with all the help which methodical study can supply.

No one can surely hesitate which of these modes of proceeding is the best—no one can be at a loss to decide that a comprehensive and complete is far better than a narrow and partial inquiry; and, therefore, no one can hesitate as to the utility of Political Economy, which is only another name for a scientific and methodical examination of momentous questions, which must, in the nature of the case, be determined either well or ill, and the determination of which must be acted upon.

Here I might stop: on this one consideration I might rest the vindication of the science. But there are one or two objections which have been brought against it which it may be useful to notice.

The first is, that it treats of an unworthy object of pursuit,—confines itself to one, and that not a very ennobling topic—wealth: in a word, that it is a mean, degrading, sordid inquiry, and tends to fix men's affections on what they are already too prone to survey with exclusive devotion.

This objection appears to me to owe any plausibility which it may have to the common use of the term wealth in its comparative or intensive sense. It is usual to employ the term as denoting the possession of an extraordinary measure of the good things of this life. Substitute for this word the phrase "economical condition of the community," and where is the objection? Is that a mean or sordid inquiry which examines the causes of national plenty or national destitution? And what is it, in fact, that occupies, and must necessarily occupy, the greater part of the time and attention of mankind, which prompts their most strenuous efforts, and a failure in which leads to the most exquisite wretchedness? Is it not, apart from hollow pretence, and in plain homely English, to get a living, to obtain a sufficiency of food, shelter, and clothing, and, in other cases, to maintain themselves and families in the rank which habit has made almost essential to their existence? And is a science which examines the general causes that aid or baffle their efforts, which aims at saving them from the evils of ignorant policy, and at opening the freest and most fertile fields for their industry — is such a science to be stigmatised as unworthy in its purpose?

That, surely, would be a blessed system of knowledge which should contribute to place human beings above starvation, and elevate even the lowest of society to comparative plenty; nay, it would be a blessed science if it did nothing more than mitigate the hardships which it could not convert into comfort and happiness.

It must force itself, too, on every mind, that those who take this apparently high moral ground, although really false position, can hardly be aware of the close connection between the economical, the intellectual, and the moral condition of the community.

"Nature herself," says a modern writer, "forbids that you should make a wise and virtuous people out of a starving one. Men must be happy in themselves before they rejoice in the happiness of others; they must have a certain vigour of mind before they can, in the midst of habitual suffering, resist a presented pleasure; their own lives, and means of well-being, must be worth something before they can value so as to respect the life and well-being of any other person. This or that individual may be an extraordinary individual, and exhibit mental excellence in the midst of wretchedness; but a wretched and excellent people never yet has been seen on the face of the earth."*

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* Encyclopædia Britannica, art. Education (I think).

Another objection to the science under review is, that it has been found to contain numerous errors.

Now this charge may be admitted without conceding what is meant to be inferred from it, that Political Economy should on that account be set aside. Where is the science concerned with events, material or mental, that has not had to struggle through errors of the grossest character? Is it Chemistry? look to the doctrine of absolute levity. Is it Natural Philosophy? look to Nature's horror of a vacuum. Is it Astronomy? look to the immense blunder of placing the earth in the centre of the solar system, and even of the universe. Is it Physiology? look to the long-continued ignorance of the circulation of the blood, and all the errors implied by it. Is it Metaphysics? look to the doctrine presented in various phases, that ideas are things distinct on the one hand from external objects, and from the mind on the other. Is it Morals? look, if you can bear the sight, to the principles, that it is justifiable to blast the happiness and crush the very soul of a man with a black skin or a scanty creed.

No! the human understanding is on every subject fallible, but on every subject capable of surmounting its errors.

"If," as I have said on another occasion, "we trace the history of any science, we shall find it a record of mistakes and misconceptions, a narrative of misdirected and often fruitless efforts; yet if amidst all these the science has made a progress, the struggles through which it has passed, far from evincing that the human mind is prone to error rather than to truth, furnish a decisive proof of the contrary, and an illustration of the fact, that in the actual condition of humanity mistakes are the necessary instruments by which truth is brought to light, or at least indispensable conditions of the process."*

This is remarkably applicable to the science of Political Economy. Multifarious in its facts, and requiring great closeness in its deductions, it must necessarily have erred in the past, and must still be imperfect for ages to come; but, in the mean time, it comprehends a large body of truths which cannot be neglected without individual detriment and national suffering.

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* Essays on the Formation and Publication of Opinions.

DISCOURSE V.

ON THE LAST REFORMATION OF THE CALENDAR IN ENGLAND.

SEVERAL circumstances having recently drawn my attention to the reformation of the Calendar in England, which took place about the middle of the eighteenth century, it occurred to me that a short paper on the subject would not be useless or unacceptable to the Society before which I have the honour to appear. It is, I am persuaded, a matter which is very little understood, but on which it is important to possess precise information.

By a Calendar is meant a register in which every month and every day of the year is designated by a particular name. After the true length of the solar year has been ascertained, the rest is principally an affair of naming the days in a convenient and consistent manner.

The chief desirable point in forming a Calendar is, that the same names should be given every year to the days on which the sun and the earth are in the same relative position; or, to express it more precisely, on which the sun is in the same parts of the ecliptic: for instance, that the day of the vernal equinox should always be named the

21st of March, or receive some other definite and unvarying appellation; and, in like manner, that the day of the summer solstice should be named the 21st of June, or be otherwise precisely designated.

If the apparent revolution of the sun from one vernal equinox to another were completed in an exact number of days, this would be a perfectly easy matter. The whole difficulty of adjusting the Calendar arises from the fact, that while our globe is revolving round the sun from vernal equinox to vernal equinox, it does not complete an exact number of revolutions from midday to midday on its own axis. The annual revolution takes 365 days and the fraction of a day. In this fraction, which is about a quarter of a day, lies the whole source of confusion and perplexity. This little difference it is which has thrown the world wrong in its chronological reckoning.

It is obvious, that the solar year being thus 365 days and a quarter of a day, or thereabouts, if you reckon only 365 days in the year in your Calendar, and if the vernal equinox at the commencement is on the 21st of March, in four years it will happen on the 22d of March; and thenceforward you will get further and further wrong by one day in every four years. At this rate, in less than four hundred years, the day of the vernal equinox, having passed successively through every intermediate name, would be designated the 21st of June.

On the other hand, if you make your year consist of 366 days, the vernal equinox in four years will fall three days later, namely, on the 18th of March, and you will plunge into error at a three times faster pace than on the former plan. In about 125 years, under this system, the day of the vernal equinox would come to be called the 21st of December.

Such is the dilemma in which mankind are placed. The problem they have to solve is, to prevent the vernal equinox from making that tour of the days and months, either forward or backward, which I have just described; and philosophers have been called in to assist in curbing, if I may so express it, its erratic propensity; or, to change the metaphor, in checking its natural preference of a sliding-scale to a fixed duty. It would be only wearying your attention if I were to describe the various expedients adopted for this purpose. It will be sufficient to go back to the first tolerably simple and correct method of meeting the difficulty, which is to be found in the Calendar introduced by Julius Cæsar. He and his coadjutors assumed the solar year to be exactly 365 days and six hours; and by making every fourth year consist of 366 days, which was an admirable improvement on former devices, they imagined that they had achieved a Calendar which would never require further correction.

But the fraction of a day again threw the world wrong. In assuming this fraction to be exactly six hours, they reckoned too much by about eleven minutes. When the Julian Calendar was adopted in the year 45 before the Christian era, the vernal equinox was on the 25th of March. 371 years later, namely, at the time of the general Council of Nice, in the year A.D. 325, it happened on the 21st of that month. The excess of about eleven minutes every year had during that interval occasioned a retrogression of four days.

No successful attempt at rectifying the increasing discrepancy was made till the latter end of the sixteenth century, when Pope Gregory XIII., with the assistance of the most learned mathematicians and astronomers (who are said to have been engaged half a score years in discussing the subject), resolved to set the matter right. At this time the vernal equinox had receded ten days farther, that is, from the 21st to the 11th of March, since the before-mentioned year, A.D. 325; and it was determined to restore it to the 21st. In order to correct so important a deviation, Gregory ordained that the 5th of October, 1582, should be called the 15th. Ten days were thus eliminated from that year. The 5th and the 14th of October, with all the intermediate days, never saw the light: more correctly speaking, the names of ten days were dropped from the Calendar and never used; the whole matter, as I have already explained, being an affair of naming.

This correction restored their former names to the different days of the year, and the day of the vernal equinox was again called the 21st of March. But to correct past error was not all: it was necessary to prevent these slippery elements from getting wrong again. As intercalating a day every fourth year, or, as we oddly phrase it, making every fourth year a *leap*-year, was too much, Gregory enacted, that the year beginning a nominal century, which is sometimes called the centurial year, should be exempt from taking an additional day, except in the case of every fourth century. Thus, the years 1700 and 1800, which on the Julian system would have been leap-years, were excluded from a leap. The year 1900 will be similarly debarred, but the year 2000 will be permitted to take one.

By this provision, it is plain that three days are retrenched from the Julian year in four hundred years. The excess in the Julian Calendar is strictly three days in 390 years; but this small discrepancy cannot make itself felt for an exceedingly long time to come: it will amount to a day in three or four thousand years.* The suppression of a leap-year once in every such period would consequently be an adequate rectification.

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* The difference will amount in 10,000 years to 2 days, 14 hours, 24 minutes, which is less than a day in 3000 years. This error, says Sir John Herschel, may be avoided by declaring that years divisible by 4000 shall consist of only 365 days *Outlines of Astronomy*, p. 629.

The reception which so necessary and so excellent a reformation of the Calendar met with in the world is a notable example of the way in which passion and prejudice deal with improvements; and more especially, how theological divisions prevent or retard the adoption of the most beneficial measures.

The general facts respecting the adoption of the reformed Calendar are, that it was immediately received by Spain, Portugal, and part of Italy; in the same year by France and Denmark; in 1583 and 1584 by the German and Swiss Catholic States; partially by the Low Countries in 1582, and universally in 1700; in the latter year by the German and Swiss Protestant States generally; and not till 1751 by England. Sweden adopted it the subsequent year, while Russia and Greece have never admitted it, but stand alone in the barbarous pertinacity of adhering to the old uncorrected system. In Scotland, it deserves to be recorded, as early as 1599 the year was ordered, by a proclamation dated December 17, to commence on the first of January ensuing;* but there was no rectification of the difference of days between the Julian and the Gregorian calendar (amounting at that time to ten days), either then or subsequently, till the Act of the British Parliament, to be hereafter mentioned, in 1751.

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* The Chronology of History, by Sir Harris Nicolas, p. 40.

It also deserves to be recorded that in the twenty-seventh year of the reign of our Elizabeth an effort was made to confer on England the benefit of the reformed Calendar. On the 16th of March, 1584–5, a Bill was read the first time in the House of Lords, entitled "An Act giving Her Majesty authority to alter and new make a Calendar, according to the Calendar used in other Countries." It was read a second time on the 18th of that month, after which all traces of the proposed measure have disappeared.*

Through the whole of these facts may be traced the influence of religious partisanship and ecclesiastical authority. The reformation of the Calendar appears to have been originally undertaken by Gregory from a desire that the moveable feast of Easter might be observed as nearly as possible at the same time of the year as it had been immediately after the Council of Nice, which could not be effected without correcting the civil year so that the vernal equinox should fall on the 21st of March, as it had done at the period of that general council.

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* The Coronology of History, by Sir Harris Nicolas, p. 34. While the present volume was passing through the press, the author had the pleasure of reading an interesting account of this attempt, in the "Gentleman's Magazine" of November last. It appears that the English Government, whose conduct on the occasion was "wise and manly," were obliged to abandon the measure chiefly by the hostility of the bishops. One of the episcopal reasons is worthy of notice; it was, that the alteration was of no great importance, *because the latter day was approaching.* The grand motive of their opposition, however, was their repugnance to the slightest semblance of submission to what they deemed the arrogance of the Pope.

As might be supposed, the Catholic States immediately adopted an alteration which was in harmony with their feelings of reverence for the past, and which emanated from the head of their own church: the Protestant states, although cultivators of Astronomy and History, who could not plead ignorance of its value, appear to have rejected it at first because of the source whence it proceeded; and it is not therefore to be wondered at, that the countries which rank amongst the lowest in point of civilisation in Christian Europe, and where the Greek form of Christianity prevails, still stand aloof.

From the preceding account we gather that the last reformation of the Calendar required 170 years to win its way to our own self-styled enlightened country, after it had been adopted by other nations on whom we are accustomed complacently to look down.

At length, however, in 1751, the subject was brought a second time under the notice of Parliament, and an Act was passed abolishing the Old Style, as it was called, and conforming the civil year to the new; in other words, adopting the Gregorian Calendar, not only in respect of the vernal equinox, but also in respect of the commencement of the year.

Before that time, the civil year in England had commenced on the 25th of March, and not, as it at present commences, on the 1st of January; and as no rectification had taken place for the excess in the intercalation of leap-years on the Julian system, our reckoning had deviated from that of the Continent by eleven days.

Thus, both in the time of commencing the year and in the naming of the days of the month, we differed widely from our neighbours. Take, for example, the year preceding our adoption of the New Style.

Jan. 1. 1750.	in our civil year was	on the Continent,	Jan. 12. 1751.
31. 1750	„	„	Feb. 11. 1751.
Mar. 24. 1750	„	„	Apr. 4. 1751.
25. 1751	„	„	Apr. 5. 1751.

The alteration, therefore, which it became necessary to make, and which Parliament was at length wise enough to enact, consisted of two principal parts. 1. It was ordered that the year should in future (namely, after the last day of December, 1751) commence on the 1st day of January, instead of the 25th day of March, as heretofore; so that the ensuing January 1. should be called January 1. 1752. 2. It was ordered that eleven days should be left out of the month of September, 1752, by calling the day after the 2nd of that month the 14th. Thus both the years 1751 and 1752 were, if I may so express it, curtailed of their fair proportions. Instead of lasting from March 25th to the ensuing March 25th, the year 1751 was terminated on the 31st of December; and the year 1752 was shortened by the elimination of September the 3rd and September the 13th, with all the intermediate days. People went to bed in that year on the 2nd of September and got up on the 14th. Hence that particular tract of time in England which passed in all legal and civil transactions under the denomination of A.D. 1751 consisted of no more than 282 days, and the year 1752 (which was a leap year) of only 354 days. There was no January in 1751, no February, and only seven days of March; and in 1752 September counted only nineteen days.

Besides the alteration in the commencement and in the denomination of the days of the civil year, the Bill provided for determining the time for celebrating the feast of Easter, so as to correspond with the practice of foreign countries; and also for the payment of rent and the transaction of other business which would be affected by the reformed reckoning. All necessary precautions appear to have been taken to obviate the little inconveniences which might arise from the change; and the methods adopted with that view in France and other countries were consulted and followed.

It may be mentioned, in addition to these particulars, that under the Old Style the Society of Friends reckoned March the first month, but in 1752 (viz. after December, 1751) they called January the first month, and of course March the third month; and in compliance with the Act, they omitted eleven nominal days in September of that year.

Such a change as the one which I have now described, although absolutely indispensable, could not, as you may suppose, be carried out without some inconvenience and confusion, which it required, and still requires, considerable care to obviate.

As an illustration of the apparent anomalies which might be the effect of it, and the confusion which might arise, let us suppose the case of a person born on the 24th day of March, 1750, according to the then civil year. As the year 1751 commenced the day after, and ended on the 31st of December following, the first nominal anniversary of his birth would be March 24. 1752, when he would appear to be two years old, although twelve months after, on the 24th of March, 1753, his age would be short of two years by eleven days. The second anniversary of his birth would be really April 4. 1753, on which day, and not before, he would have completed two cycles, one of 366* and the other of 365 days.

The chronological confusion here illustrated by an hypothetical case — a case which, in fact, describes the position of all persons born between December 31. 1750 and March 25. 1751†—is still apt to perplex those who have to deal in any way with the dates of events and documents anterior to the parliamentary reformation of the Calendar. For example: the anniversaries of remarkable occurrences which happened in England before the adoption of the New Style are, as given in some, if not all, of our almanacs, really erroneous, and may lead to further errors, unless their character is clearly understood.

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* 1752, being a leap-year.

† And not only of such but of all (*mutatis mutandis*) born in

Respecting such records the editors of a popular annual publication say:—"In the anniversaries given in the British Almanac, the alterations of style made in 1752 have not been followed, as any correction of date would have embarrassed the reader in historical and biographical references."*

Accordingly, in that almanac, the execution of Charles I. is recorded as having taken place on the 30th of January, 1648, and the revolution (more properly the acceptance of the crown by William and Mary) on the 13th of February, 1688, both of which dates are Old Style, and also according to the old civil year. This plan may possibly be the best, although I see some reason to doubt it; but, at all events, it will mislead the reader, unless he exactly comprehends it and carries it in his mind.

Even if we lay aside the consideration of the discrepancy of ten or eleven days between the Julian and the Gregorian Calendar, the simple

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the corresponding period of any year preceding, who were living after the alteration.

* Companion to the Almanac for 1828.

difference in the modes of commencing the year is itself a continual source of perplexity.

Although, before the reformation of the Calendar in this country, the civil year commenced, as we have seen, on the 25th of March, the historical year, as it is called, had, for a long period antecedent to that reformation, commenced on the 1st of January; that is to say, historians had long adopted that mode of dating the events which they chronicled.

Thus, to take a remarkable period for the sake of illustration: while in the courts of law, and in all public instruments, the day after December 31. 1688 was named January 1. 1688, it will be found in the writings of historians to be denominated January 1. 1689. Hume, for example, after recording that James II. fled on the night of December 12. 1688, and a second time on the 23rd of the same month, proceeds to state that the English Convention was assembled on the 22nd of January, 1689; but as this was only thirty days after the second flight of the king, it figures in the civil year as January 22. 1688. Another point should be distinctly understood. While the difference of ten or eleven days between the Julian and the Gregorian Calendar affects every date in the year, the nominal discrepancy of twelve months between the civil and the historical year can affect no dates but such as occur in the interval between December 31. of any year and the subsequent 25th of

March, and only the dates of such events as happened previous to the reformation of the Calendar in England. Sometimes the mode of dating in this interval (and an excellent mode it is) expresses both the civil and the historical year, as 1688–89, 1750–51, or $168\frac{8}{9}$, $175\frac{0}{1}$, which notation is of course inapplicable to any other part of the year.

It must be also borne in mind, in regard to such dates, that the historical method, as employed by English historians, leaves the surplus intercalation of ten or eleven days uncorrected, and does not consequently tally with the continental reckoning any more than with the English civil year.

A memorable event in English history, which has been already adverted to, may be again cited for the purpose of placing clearly before my hearers both sources of discrepancy in dating. The execution of Charles I. took place, according to the civil year, on the 30th of January, 1648; according to the historical year, on the 30th of January, 1649; but according to the Gregorian Calendar, or New Style, on the 9th of February, 1649.*

It is important to remark that the term Old Style indicates only the difference of the ten or eleven nominal days between the unreformed and the reformed Calendar, and not the difference in commencing the year. In documents prior to 1752, where both the civil and the historical years are given, the initials O. S., signifying Old Style, are frequently found appended to the date, implying simply that the day is named according to the Julian and not the Gregorian Calendar. Horace Walpole, for example, dates a letter January 7. 1741–42, O. S., and many of Lord Chesterfield's letters show the same fact; as, for instance, the consecutive dates of two of them, March 6. O. S. 1747, and March 27. O. S. 1747, where the O. S. has plainly no reference to the time of commencing the year, for the first date, which according to the civil reckoning would be 1746, conforms in point of fact to the New Style in the number of the year.

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* The difference between the Old and the New Style up to the year 1699 was only ten days: after 1700, it was eleven days, and after 1800, twelve days: the two former differences existed between the reckoning of the English civil year and the Gregorian Calendar; the latter (12 days) now subsists between the English and the Russian Calendar.

Although the phrase Old Style was thus used to mark only the manner of designating the days, the phrase New Style always indicates conformity with the Gregorian Calendar, both in the naming of the days and in the commencement of the year.

Sir Harris Nicolas mentions that about the year 1650 a practice was introduced of using both the Old and the New Style by putting the old as the numerator and the new as the denominator of a fraction; *e. g.* June $\frac{6}{16}$ 1651:[*] but from the instances quoted by him it would appear that this practice was adopted solely or principally in our transactions and negotiations with foreign countries.

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[*] Chronology of History, p. 321.

Charles II.'s letter from Breda to the two Generals was dated in this manner—April $\frac{4}{14}$ 1660.*

The commencement of the civil year on the 25th of March had long before 1751 been felt as a great inconvenience; and common usage in letters and in the ordinary affairs of life seems to have gradually lapsed into the historical method.

The preamble of the Act passed 24 Geo. 2., 1751, for the purpose of altering the Style, as already mentioned, sets forth that the practice of beginning the year on the 25th of March "had produced various inconveniences, not only from its differing from the usage of neighbouring nations, but also from the legal computation in Scotland, and from the common usage throughout the whole kingdom."

The common usage, however, here spoken of, could scarcely have been of long duration, at least not universally; for I find instances of beginning the year on the 25th of March, in periodical works, about a quarter of a century before the passing of the Act. Thus, in a weekly publication well-known under the title of Cato's Letters, No. 21. is dated March 18. 1720; No. 22. (the week after), March 25. 1721; No. 121., March 23. 1722; and No. 122., March 30. 1723: which dates imply that the old method was at that time by no means obsolete.

Some light is thrown on this point by a pamphlet published by Henry Wilson in 1735, which states that the year was at that time reckoned to begin on the 1st of January in the common licensed almanacs, and also in the Calendar for Lessons in the Common Prayer, although the rubric enjoined the year to begin on the 25th of March.*

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* Memoirs of Samuel Pepys, vol. v. p. 66.

About this period, or soon after, the employment of the double date, showing both the civil and the historical year, seems to have been common in private correspondence. West, writing to his friend Gray, the poet, dates February 21. 1737–38. Both Gray and Horace Walpole, while on the Continent in 1739 and 1740, conform to the continental method by using the New Style. Walpole, being at home again in December 1741, reverts to the Old Style. On the following 7th of January he uses the double date 1741–42; but fifteen days later he employs the single historical date, January 22. 1742. In the ensuing February he resumes the double year 1741–42. Afterwards he puts the single historical year without variation, as if by that time it had become the established custom, and could not lead to error.

I cannot conclude this short notice of the subject without adverting to the person who conferred upon his country the great benefit of rectifying its civil year, and to some of the circumstances attending it. It is natural to suppose that he must have been a man of eminent science, or distinguished by grave and philosophical pursuits. You will, therefore, probably be surprised to learn that it was no other than the gay and dissipated Earl of Chesterfield, who wrote the celebrated Letters to his Son. But notwithstanding the vain and frivolous qualities of that nobleman, there was in him a large fund of good sense, good taste, and sagacity. His administration of the affairs of Ireland alone shows how much solid merit lay under the superficial levity of his character. Dr. Maty, in his Memoirs, tells us that his lordship was led to undertake the task chiefly from the confusion which the existing Calendar introduced into historical transactions, and into intercourse with other states. "The inconveniences," continues Dr. Maty, "were evident; but the difficulty of obviating several inconveniences attending a sudden alteration, and especially in overcoming people's prejudices, were not less so. These difficulties he (Lord C.) found still more considerable than he had imagined. Having consulted the Duke of Newcastle, that minister, then in the zenith of his power, seemed alarmed at so bold an undertaking. He conjured the Earl *not to stir matters that had long been quiet; and added, that he did not love new-fangled things.*" Lord Chesterfield, however, persevered; consulted men of eminence in science, law, and politics, and, having furnished himself with all requisite knowledge for the occasion, introduced a Bill into the

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* Chronology of History, by Sir Harris Nicolas, p. 39.

House of Lords on the 25th February, 1751, O. S.*, "For regulating the Commencement of the Year, and for correcting the Calendar now in use." On the following 18th March he moved the second reading of the Bill: the motion was seconded by the Earl of Macclesfield, who was afterwards President of the Royal Society—a man of real science, and fully conversant with the whole subject. He explained it to his brethren of the peerage in a clear and argumentative speech, which has come down to us.†

In the course of his address he did ample justice to those who had originated and prepared the measure.

"I believe," said Lord Macclesfield, "I need not tell your lordships that the first design of the Bill was formed by the noble Earl (Chesterfield), who presented it to the House; and whose sagacity to discern does not exceed his inclination to redress any inconveniences which his fellow-subjects may labour under.

"This Bill was, under his lordship's directions, drawn, and most of the tables prepared, by Mr. Davall, a barrister of the Middle Temple, whose skill in Astronomy as well as in his profession rendered him extremely capable of accurately performing that work, which was likewise carefully examined and approved of by two gentlemen, whose learning and abilities are so well known that nothing which I can say can add to their characters — I mean Mr. Folkes, President of the Royal Society, and Dr. Bradley, His Majesty's Astronomer at Greenwich."*

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* In our *civil* year this was Feb. 25. 1750.

† Parliamentary History, vol. xiv. p. 981.

Lord Chesterfield's own account of the matter is also extant; and as it is both amusing and instructive, I will venture to quote a passage from it of some length.

After mentioning that Gregory's Reformed Calendar had been immediately received by all the Catholic powers of Europe, and afterwards adopted by all the Protestant ones, except Russia, Sweden, and England, he proceeds: "It was not, in my opinion, very honourable for England to remain in a gross and avowed error, especially in such company: the inconveniency of it was likewise felt by all those who had foreign correspondents, whether political or mercantile. I determined, therefore, to attempt the Reformation. I consulted the ablest lawyers and the most skilful astronomers, and we cooked up a Bill for that purpose. But then my difficulty began: I was to bring in this Bill, which was necessarily composed of law jargon and astronomical calculations, to both of which I am an utter stranger. However, it was absolutely necessary to make the House of Lords think that I knew something of the matter, and also make them believe that *they* knew something of it themselves, which they do not. For my own part, I could just as soon have talked Celtic or Sclavonian to them as astronomy, and they would have understood me full as well; so I resolved to do better than speak to the purpose, and to please instead of informing them. I gave them, therefore, only an historical account of Calendars from the Egyptian down to the Gregorian, amusing them now and then with little episodes; but I was particularly attentive to the choice of my words, to the harmony and roundness of my periods, to my elocution, to my action. This succeeded, and ever will succeed: they thought I informed, because I pleased them; and many of them said that I had made the whole very clear to them, when, God knows, I had not even attempted it. Lord Macclesfield, who had the greatest share in forming the Bill, and who is one of the greatest mathematicians and astronomers in Europe, spoke afterwards with infinite knowledge and all the clearness that so intricate a matter would admit of; but as his words, his periods, and his utterance were not near so good as mine, the preference was most unanimously, though most unjustly, given to me."*

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* Parliamentary History, p. 991.

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* Letter to his Son, March 18, O.S. 1751. In this account,

In consequence of all these pains and precautions the Bill passed both Houses without opposition, and became the law of the land, as it still continues to be.

I have already alluded to the obstacles which this great reform had to encounter, and mentioned its reception by the then minister, the Duke of Newcastle.

But we are not to suppose that such ignorance and prejudice were monopolised by statesmen. There are several incidents on record illustrative of the spirit in which the innovation was viewed by the people; and as they contain a moral lesson still greatly needed, as well as form an amusing episode to my rather dry discourse, I will make no apology for introducing them. The preceding account has endeavoured to place in a clear light that the whole reform consisted in a change of names; and it seems almost incredible that it should have ever been regarded otherwise: but there is no limit to the misconceptions of ignorance. It was imagined by some sapient heads, that when Parliament dropped from the year the names of eleven days, it had actually annihilated the days themselves.

This egregious blunder was divertingly exhi-

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we may suspect, on the part of Lord Chesterfield, some exaggeration of his own deficiency of knowledge, arising from his predominant desire to impress upon his son the powerful influence of *manner* in all the affairs of life.

bited when the son of Lord Macclesfield stood a contested election in Oxfordshire, about three years after the passing of the Bill in the introduction of which his father, as we have seen, had taken so meritorious and prominent a part. Absurd as the incident may appear, even beyond the usual absurdities of elections, one of the most vehement cries raised against the son on the occasion was, "Give us back the eleven days we have been robbed of."

This was too good a thing not to be seized upon by the wits of the day. It has accordingly been immortalised by Hogarth, who, in his picture of the Election Feast, introduced a banner carried by one of the crowd, bearing the inscription, "GIVE US BACK OUR ELEVEN DAYS."

The same ludicrous misapprehension was also ridiculed in rhyme, a specimen of which I have before me; but it partakes, perhaps, too much of the doggrel character to be worth reciting.*

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* In seventeen hundred and fifty three,
The style it was changed to Popery,
But that it is liked, we don't all agree;
Which nobody can deny.

When the country folk first heard of this act,
That old Father Style was condemned to be rack'd,
And robb'd of his time, which appears to be fact;
Which nobody can deny.

It puzzled their brains, their senses perplex'd,
And all the old ladies were very much vex'd,

The foolish and disgraceful blunder did not, however, stop here; it was exhibited on a more solemn occasion. When Bradley, the celebrated mathematician and astronomer (who, as you have already learned from a passage in Lord Macclesfield's speech, had lent his assistance in preparing the Bill), was some years afterwards dying of a lingering illness, the common people ascribed his sufferings to a judgment from Heaven for having had a share in that impious undertaking.

Thus it is that almost every improvement has to breast the current of ignorance and prejudice, and that the cry of impiety and irreligion is raised against the clearest advances in science and civilisation.

Not dreaming that Levites would alter our text;
Which nobody can deny.[1]

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[1] From the Jew's Triumph, a ballad, published 1753 or 1754. See England under the House of Hanover, by Thomas Wright, vol. i. p. 254.

DISCOURSE VI.

ON THE GENERAL PRINCIPLES OF PHYSICAL INVESTIGATION.

THE subject to which I have to solicit your attention this evening is, the General Principles of Physical Investigation. We hear almost every day a great deal said on the improved methods of philosophising, on induction, and on the inductive philosophy of Lord Bacon; but it appears to me, that the true principles of scientific investigation, although pretty generally disseminated, are rather felt than clearly and accurately understood. We learn them from imitation,—from seeing them exemplified in the researches of eminent philosophers —and few think of making them an object of distinct and separate attention. Yet it is manifestly of importance that the inquirer should be perfectly aware of the nature of the process in which he is engaged, in order that he may conduct it in the best practicable manner, avoiding such needless embarrassments and errors as might retard his progress and vitiate his results. When he has a distinct conception of the object and nature of physical investigation, he will be best able to conduct it, on any occasion, to a successful issue.

A simple and accurate exposition of these important points would, therefore, be of the greatest utility. Although I have not the presumption to think that I can present such a one to my hearers on the present occasion, I venture to hope that I may be able to lay before them a few useful suggestions connected with the subject.

In the first place, it will be well to settle with ourselves what is the ultimate object of all physical investigation. It has been stated, on high authority, that this object is to control the powers of nature for the advantage of mankind; to make the qualities of material objects subservient to human happiness. This is frequently insisted upon by Lord Bacon, in his own peculiar manner. "The greatest error of all the rest," says he, "is the mistaking or misplacing of the last or farthest end of knowledge: for men have entered into a desire of learning and knowledge; sometimes upon a natural curiosity and inquisitive appetite; sometimes to entertain their minds with variety and delight; sometimes for ornament and reputation, and sometimes to enable them to victory of wit and contradiction; and most times for lucre and profession; and seldom sincerely to give a true account of their gift of reason, to the benefit and use of men: as if there were sought in knowledge a couch whereupon to rest a searching and restless spirit; or a terras for a wandering and variable mind to walk up and down with a fair prospect; or a tower of state for a proud mind to raise itself upon; or a fort or commanding ground for strife and contention; or a shop for profit or sale;—and not a rich storehouse for the glory of the Creator and the relief of man's estate."

This passage, splendid in its imagery rather than precise in its purport, appears to me to lose sight of a distinction to be drawn between the ultimate result of investigation on the happiness of mankind, the end to be kept in view during our researches, and the actuating feelings which impel men to undertake them. These are somewhat indiscriminately huddled together.

The ultimate result is unquestionably, as he says, "the Glory of the Creator," and "the relief of man's estate," in the latter of which division should be included (whether he intended it or not) the elevation of the human race, in their moral and intellectual character, as well as in their physical condition. Assured, however, that to dissipate ignorance and error cannot fail to redound both to the glory of God and to the welfare of man, the end to be kept in view by every inquirer throughout his researches is solely the attainment of truth, irrespective of any other circumstances whatever. To ascertain the real properties of ourselves and of the objects around us, and the actual events which are now occurring or have occurred in past times, is surely the simple purpose of all scientific or philosophical investigation, when once begun.

With regard to the motives described as inducing men to enter on the pursuit of knowledge, and so disparagingly treated by Bacon, they are, as far as I can see, necessary elements in human action; and could they be wholly repressed, science would be stopped in its progress. Curiosity or inquisitive appetite is, in this case, only another name for the laudable craving after knowledge: the wish to entertain the mind in these pursuits with variety and delight points to one of the purest of our enjoyments, and is, in truth, a rational desire to gather by the way some of the finest of that fruit which Bacon sets before us, as one of the ultimate ends of all investigation; while the love of reputation, and the desire to display intellectual ability, and to acquire the good things of this life, are constituent parts of human nature, salutary in their influence when kept in subordination to higher motives. In the progress of science, all these actuating principles play a more or less useful part amongst its diversely constituted votaries, and are not injurious so long as they do not overstep their proper limits.

There are doubtless many cases in which the ultimate result of all knowledge in manifesting the glory of the Creator, and elevating the condition of mankind, is the immediate and paramount inducement for engaging in a course of investigation. It is a noble motive, and even when it is not the immediate inducement, it is a consideration which will often lighten, and should always animate the researches of the inquirer.

Since the days of Bacon there have been splendid instances of success in attaining the end which he has described as the relief of man's estate. Almost every department of knowledge, indeed, presents us with instances in which the properties of material bodies have been made subservient to human advantage. On a point which is so well understood by all, I will detain you by only one illustration. The art of Navigation, as practised in our own day, exhibits in itself a concentration of numerous and wonderful adaptations of material qualities to the service of man. The great problem in this art evidently was, to tell at any moment the exact position of the ship on the surface of the globe, that the mariner, in the exercise of his dominion over nature, might compel the winds to speed him to his destination. By a multiplicity of discoveries and inventions, man has solved this problem:—he has availed himself of the properties of the loadstone to form the compass;—of the mechanical qualities of matter to construct the timepiece;—of the laws of light, in the invention of the quadrant and the telescope: and with these magical wands of science he can traverse the whole of that mighty expanse of waters into the mysteries of which the enterprise and ingenuity of Greece and Rome failed to penetrate. Even one of the inventions I have mentioned, taken by itself, is a beautiful illustration of the skill with which the human mind has adapted material properties to useful purposes,—I allude to the nautical time-pieces or chronometers which have recently been carried to so high a degree of perfection, and the utility of which I cannot better describe than in the words of an excellent expositor of natural philosophy: "The author may perhaps be excused," says he, "for mentioning a moment of surprise and delight which he experienced on first seeing their singular perfection experimentally proved. After months spent in a passage from South America to Asia, his pocket chronometer, and others on board, announced one morning that a certain point of land was then bearing east from the ship at a distance of fifty miles; in an hour afterwards, when a mist had cleared away, the looker-out on the mast gave the joyous call of 'Land ahead!' verifying the report of the chronometers almost to a mile after a voyage of thousands. It is allowable at such a moment, with the dangers and uncertainties of ancient navigation before the mind, to exult in contemplating what man has now achieved. Had the rate of the wonderful little instrument in all that time been quickened or slackened ever so slightly, its announcement would have been worse than useless; but in the night and in the day, in storm and in calm, in heat and in cold, its steady beat went on, keeping an exact account of the rolling of the earth and of the stars; and in the midst of trackless waves, which retain no mark, it was always ready to tell its magic tale of the very spot of the globe over which it had arrived." *

When we take a comprehensive survey of the whole business of that physical investigation, the ultimate result of which is to give us this beneficial control over nature, it appears to divide itself into two great departments. One is concerned with the actual constitutions and relations of bodies; the other with the motions which are taking place among them.† I do not mean to affirm that these are perfectly distinct branches of inquiry, for in almost every science they naturally blend themselves together; but there are some sciences more especially devoted to the former, and some to the latter. Thus the various branches of Natural History are chiefly occupied with the actual structure of material objects, while Physiology, Natural Philosophy, and Chemistry are employed in tracing the changes which bodies undergo. This latter is, in truth, the grand business of science, to which the other is altogether subsidiary. To become acquainted with the motions of matter, or, in other words, with the series of causes and effects continually taking place around us, is the main, although not the only concern of physical investigation.

It may not, perhaps, be at first admitted, but,

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* Dr. Arnott's Elements of Physics.

† "Les choses qui existent et les choses qui arrivent."— SAY.

on reflection, every one must perceive that all the events in the material universe — all the phenomena of Nature, — are merely changes in the relative positions of particles or masses of matter. "What" it will be said, "are all the brilliant appearances of the external world — the succession of the seasons, the alternation of day and night, the phenomena of vegetation and animal life, the chemical operations, the mechanical processes going on around us, — are all these mere instances of change in relative position?"

That they are so, may, I think, be readily proved. If any one tasks his conception to the utmost, he will find that there are only three possible changes in matter which he can form any idea of, — the creation of matter, the extinction of matter, and a change in relative position amongst the masses or particles of the matter which actually exists. Now, in the present course of Nature, we have no evidence of the production of new matter, — not an iota of evidence; — no philosopher of modern times has ever maintained that we have. It is the same with the extinction of matter: no act of extinction, no phenomenon of annihilation, has ever yet crossed the inquiries of the searcher into the secrets of Nature. The Chemist, who pursues substances through all their changes, finds them indeed assume new forms, enter into new combinations, cast off their sensible properties, and escape from all tests of their existence but the grasp of gravitation; yet in all these metamorphoses (as far, at least, as ponderable matter is concerned) he loses not a particle of the original quantity.

There remains, then, only the other case,—a change in relative position,—which you will find includes every phenomenon of physical mutation that can be brought within our cognizance.

If we confine ourselves, however, to changes in any particular body, these may obviously arise from any one of three causes corresponding to those before mentioned. In such a body there may be an accession of matter, a loss of matter, or a change in the relative situation of its component parts.

Take, for example, a rod of bright steel; it may be rusted by exposure to moisture, which is an addition to its bulk from the oxygen of the water; it may be abraded by friction, and thus become less and lighter; and the relative situation of its constituent particles or their molecular arrangement may be changed by the whole being subjected to vibration.

This mode of stating the subject exhibits the business of Philosophy in its simplest aspect, showing that it consists in observing the changes which the universe presents in the relative situation of the bodies, whether masses or particles, that compose it. These changes observed as succeeding each other, are causes and effects; and the chief difficulty, as will be hereafter explained, is to ascertain the exact sequences in which they occur, or what causes produce what effects.

It was long thought that there were images, or phantasms, or forms, or species, of all things in the universe by means of which we became acquainted with whatever existed; and it was believed that by merely reflecting on these species as they presented themselves to the mind, we could acquire an insight into the essence or nature of the things themselves. As from the essential form or definition of a triangle, we may deduce its properties by mere reflection, so it was thought that we might deduce the qualities of bodies antecedently to experience by dwelling on these abstract exemplars.

Much of the success of Science during the two last centuries is to be ascribed to its having emancipated itself from the trammels of this dogma, the prevalence of which, in one shape or other (for it has been a very Proteus) amongst the philosophers of former days, was almost universal, and seems now almost incredible. In the first place, there is no evidence for the existence of any species, images, exemplars, or essential forms of this nature, and therefore the whole doctrine rested on a gratuitous assumption. It is manifest, further, that we can form no conception, acquire no knowledge, of external objects and their qualities, but by means of our physical organs. Every idea of them which we possess, whether of the simplest or most complex description, may be referred in the one case, and reduced by analysis in the other, to simple impressions on the senses. Hence results the truth which, obvious as it may seem, the world missed finding out for some thousands of years, that Science must avail herself in her researches of precisely the same instruments which are employed on the commonest occasions of life, namely, of the five senses. All that she can discover of a visible body is what she can discover by looking at it,—of a tangible body by touching it, —of a sapid body by tasting it. In a word, she must resort to plain observation. All physical events being merely changes in the relative position of masses or particles of matter, and all these changes being cognizable only through the senses, it follows that previous to experience we can absolutely know nothing of the properties of the material world. The simplest sequence of cause and effect could never have been foretold by the most sagacious mind. There is nothing whatever in a cause independently of our having perceived it to be followed by its effects, from which we could possibly form an idea of what it would produce. It is the boast of modern philosophy to have completely dissipated the notion that from abstract reasonings on what are termed general ideas, we could ever attain a knowledge of real existences. The very first sentence of the Novum Organum puts the matter in its true light and on its proper footing, that celebrated sentence beginning, "Homo naturæ minister et interpres," "Man the servant and interpreter of nature."

With regard to physical events, then, it is the true office of the philosopher to observe the succession of changes, the series of causes and effects, which are taking place around us. When he has once observed that a certain cause has produced a certain effect, he feels quite sure that in precisely the same circumstances the same effect will ensue. It is not necessary on the present occasion to enter into any metaphysical discussion of the nature of this confidence in the stability of the laws of nature. Every one feels it, and every one acts upon it without doubt and without premeditation.

On the principle that the same causes always produce the same effects, rests the whole body of rules for conducting physical investigation, and, indeed, the whole superstructure of science itself. If there were the least uncertainty in this point,—if a cause sometimes produced one effect, sometimes another,—inquiry would be useless; a knowledge of what had taken place hitherto, or of what was actually occurring, could be no guide for the future. In vain should we accumulate facts upon facts when the next moment might introduce us to the strangest anomalies—to water freezing at 212° of Fahrenheit, or to lead ascending in the atmosphere when dropped from the hand.

Happily, however, the laws of nature are uniform, and we may always be perfectly sure of the same effects when the same causes are in operation; but not otherwise. Any law of nature or general rule, therefore, may be applied with perfect confidence when the causes are precisely similar; but exactly in proportion as the circumstances vary, the result becomes uncertain.

It might at first sight seem a simple business to pursue scientific inquiries if, as here stated, the same causes always produce the same effects; for it would be merely observing how they once succeeded each other, and then we should be able to tell how they would succeed each other ever after. In this, it might be said, there would be little room for either mistake or sagacity.

If we rested in this remark, however, we should overlook the principal difficulty of the subject. The great difficulty of all philosophy, and of all application of experience, consists in this,—that circumstances are seldom exactly similar, that the collection of causes in operation is continually varying. If causes always acted distinctly, singly, separately, then indeed there would be no room for mistake, none for sagacity; all would be observation of the simplest kind, and application the most obvious and direct. And the same of course would hold true if, when causes were combined in their action, their combinations never varied. But causes act together, and in varying combinations; and where a number of causes are acting together, there is created a problem frequently of no easy solution—to discriminate, namely, the individual action of each. It is here the chief difficulty lies, the hardest task of philosophy commences, the principal exercise of sagacity is called for,—to allot amidst the complicated phenomena of nature each effect to its peculiar cause,—to pair them off, if I may so express it, and thus enable ourselves to follow them into new situations.

It is this commixture of the operation of causes which gives occasion for that process which in modern times we have heard so much of under the appellation of Induction, a word not applied with uniform precision. In its original meaning this word simply implies the bringing in of facts; but a mere assembling of facts as such without some ulterior purpose or design, would not fill up the idea which philosophers now attach to the term. Induction is not only the process of collecting facts, but the process of collecting them so as to ascertain their dependence as causes and effects; it is, in a word, the process of allotting effects to their causes in natural phenomena of greater or smaller complication. If causes had not been intermingled with each other in their operation, such a process as that of induction would not have been necessary. This view, if I mistake not, is the same as that presented to us by Bacon in the 105th axiom of his Novum Organum. After saying "Inductio quæ procedit per enumerationem simplicem res puerilis est," he goes on, "At inductio quæ ad inventionem et demonstrationem scientiarum et artium erit utilis, naturam seperare debet per rejectiones et exclusiones debitas:" "The induction which consists in simple enumeration is a childish process; but the induction which will be found available for scientific discoveries and demonstrations must separate the complicated phenomena of nature by excluding such circumstances as it may be necessary to reject."

This allotment of effects to their causes is a task of all degrees of difficulty. Where we have the command of the agents, as in philosophical experiments, it may often be done with complete success. There are, we will suppose, six different circumstances united in producing a complex effect, or a complicated number of effects, and I want to trace one of these effects to its cause. The problem is to determine which of the six circumstances is essential to the production of this one portion of the joint result. It is obvious, that if I have the command of the agents—if I can make a number of experiments, in which I can leave out each one of the six circumstances in its turn, and if, in the course of these trials, I see the particular effect disappear, then I may safely conclude that it was the effect of that one of the six circumstances which I had in this experiment omitted. That one element is left out, and the particular phenomenon, the cause of which I wanted to ascertain, vanishes. I may omit any of the other five, and yet the phenomenon remains; but if I omit this, it is gone. I therefore irresistibly conclude that the circumstance in question was the cause of the effect or phenomenon.

It is obvious, however, to remark that in many departments of knowledge, we have not command of the agents as we have in such philosophical experiments, so as to leave one or other of them out of the combination at pleasure. Yet we are not left without resource. Nature herself often spontaneously exhibits varied combinations in which sometimes one agent is left out, sometimes another. Our resource, therefore, in such cases is to observe a plentiful variety of instances, and from these instances we may often be as successful in drawing a just conclusion as if we could dispose the materials or agents ourselves. Here is a wide field for that quality which is termed sagacity—a quick perception of all that is like and all that is unlike in combinations presenting a general analogy or resemblance.

Perhaps these observations can be applied to no science with more pertinency than to Medicine. If, in administering a remedy, the substance given to the patient were the only principle in operation on his physical system, and if that physical system were exactly like all others, a certain definite effect would be produced which might be unerringly calculated upon; but there are many influential circumstances—as food, atmosphere, mental emotion acting at the same time; and hence there is a difficulty of telling which part of the subsequent phenomena is to be ascribed to the operation of the medicine, and which to the other circumstances simultaneously at work.

And further, since every man may be considered as a collection of physical principles—a bundle of matter—different from every other man, there is the additional difficulty presented by this variation.

Yet even here, by an attentive observance of numerous instances, the specific agency of individual causes may be traced. If, in a variety of cases presenting a general resemblance, whenever a certain circumstance is present a certain effect follows, there is a strong probability that one is dependent on the other; but if you can also find a case where the circumstance is absent from the combination, and the effect also disappears, your conclusion has all the evidence in its favour of which the case is susceptible.

When a decisive trial can be made, by leaving out, in this manner, the cause of which we wish to trace the effect, or by insulating any substances so as to exclude all agents but those we wish to operate, or in any other way,—such a decisive trial receives the title of *experimentum crucis.* One of the most interesting on record is that of Dr. Franklin, by which he established the identity of lightning and the electricity of our common machines; but it is so well known, that I prefer illustrating this part of the subject by Lavoisier's experiment to disprove the existence of such a body as phlogiston. It is a well known fact that metals are rendered heavier by calcination—tin or lead for instance; and the question arose how was this accession of weight to be accounted for? Two suppositions presented themselves; one, that some substance possessed of absolute levity might have escaped in the process; the other, that some heavy substance had been added. The former, which appears absurd enough to the present age, was the prevailing theory at the time Lavoisier made his experiment, and the substance supposed to be endued with this absolute levity was termed phlogiston. In order to determine the matter, that celebrated chemist put a quantity of tin into a glass retort hermetically sealed. After accurately weighing the vessel and its contents, he applied sufficient heat, and when calcination had been effected, he again weighed the whole, and found the weight exactly the same as before. This of course proved that no substance, light or heavy, had made its way through the glass. Proceeding with the experiment, as soon as the retort had cooled, he opened it, when the air immediately rushed in, proving that a part of the air previously in the retort had disappeared, or lost its gaseous state. On weighing the whole apparatus again, its weight was found augmented by ten grains; whence it was plain that ten grains of air had entered the retort. In the next place the calx or oxide was weighed separately, and proved to be ten grains heavier than the original metal. It was clear then that the ten grains of air — the disappearance of which had made way for the other ten grains that rushed into the retort on its being opened — had combined with the metal during calcination. Hence there was no principle of levity concerned, and the doctrine of phlogiston gave place to a truer theory.*

In the view now given, I have considered Induction as that process by which we collect a number of facts, in order to allot an effect to its cause in any complicated phenomenon. When the issue has been successful, there results a general law, or, in other words, we are able to predicate certain properties of a certain class of substances.

The formation of a general law may be easily exemplified, and it may be shown in what way it is the result of a successful process of induction. Strictly speaking, we may form a general law of any event that occurs, — we may generalise, to a certain extent, any circumstance whatever. Thus, supposing a man to have had no experience at all of the properties of matter, and to commence his acquaintance with them by taking up a stone and letting it fall to the ground. He would instinctively draw the conclusion that if dropped again it would fall again; and he might proceed to infer that all similar substances would fall if let go in the same way: but observe the number of limitations to his generalisation; or, in other words, the number of circumstances which he must include in his general inference. He would not know how far the shape of the stone would affect the result, — or the composition, — or the temperature,—or the hand by which, or the position in which, he held it; for, previous to experience, no sagacity would be able to pronounce on these, to us, apparently natural and intuitive parts of knowledge. His generalisation, to be perfectly accurate, could extend only thus far, — that bodies similar in shape, weight, composition, and temperature, to the one he had let fall from his hand, would always fall to the ground, when held in the same position, and set at liberty by the same instrument.

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* See Playfair's Works, vol. ii. p. 108.

In the process of his experience of material objects, however, he would rapidly get quit of these limitations. He would find, by a truly philosophical, as well as natural, induction, that substances of all kinds, shapes, and temperatures, held in all positions, and set at liberty, whether by the hand or in any other way, invariably fell towards the earth. At this point his general law or conclusion would have become wonderfully more general than at first; but it would not have yet been extended to its possible reach. From the tendency of terrestrial bodies to the earth, he might proceed to discover that the moon had a similar tendency; then that the planets had a similar tendency to the sun; till at length he reached the sublime generalisation, that all bodies tend to each other with forces directly as their masses, and inversely as the squares of their distances.

In all this, there would be one continued series of inductions or collections of facts, proving that certain circumstances or phenomena were *not* connected as causes with the result, namely, the tendency of bodies to each other; neither size, nor colour, nor temperature, nor terrestriality, nor position in space, nor opacity, nor luminosity: all these would be dismissed in the process of generalisation, forming so many instances of what Bacon, in the language I have already cited, terms "*rejectiones et exclusiones debitas.*"

A general law, you will perceive from what has been said, amounts to this,—that certain things which resemble each other in one property, or assemblage of properties, possess also another property, or assemblage of properties. And the great advantage of establishing such laws by induction, is, that whenever you find an object possessing the first, you may infer that it also possesses the second, although you have no direct evidence of the fact in that particular case.

It may be necessary to add, that induction does not always lead to certainty, but often only to probability of various degrees. In some cases it approaches near to what Lord Bacon designates as "*enumeratio simplex*" or simple enumeration, as when it consists in showing, by an accumulation of instances, the invariable concomitance of two or more co-existing conditions: thus, to take a familiar example, it appears, as far as naturalists have had an opportunity of examining the various species of animals, that all horned quadrupeds have cloven feet; and if a zoologist should at any time discover a new species of horned quadrupeds, he would expect to find a similar conformation in the foot. But this inference would by no means be a certain one; because one of these phenomena is not the cause of the other: the cloven hoof is merely an accompaniment of the horned head. It is probable, indeed, that they depend on some common cause, although none has hitherto been assigned; but so long as they appear nothing more than co-existing conditions, or facts always found together, it can never be laid down as a positive law of nature that one is invariably accompanied by the other.

There is also a similar kind of induction to this in mathematics. A mathematical rule is usually capable of strict demonstration; it can be proved to hold necessarily from the definitions and principles previously laid down and admitted. Nevertheless, it occasionally happens, that a rule or formula is invented and applied before it can be strictly demonstrated. In this case it is said to be established by induction; that is, it has been tried and found to hold good, in a multiplicity of instances, without an example of failure; and hence it is inferred that it will hold universally. It was in this way that Sir Isaac Newton established his celebrated Binomial Theorem,—which is only a method of raising a binomial quantity (or one consisting of two terms) to any required power, or extracting any root of it. "The truth of this method," says Dr. Hutton, "was long known only by trial in particular cases; nor does it appear that even Newton himself ever attempted any direct proof of it: however, various demonstrations of the theorem have since been given by the more modern mathematicians."

That considerable caution is nevertheless requisite even in mathematical induction, is proved by an instance mentioned by Euler, and quoted in a recent account of Lord Bacon's "Novum Organum.* It was found that, if to the square of a number were added the number itself + 41, the result would be a *prime* number — that is, a number which has no divisors. Thus, if to the square of 2, which is 4, were added 2 + 41 or 43, the result would be 47, a number which is obviously prime. As this rule holds for the first forty numbers, from zero upwards, an incautious mathematician might have inferred that it was a universal law: on proceeding, however, to the 41st term, the result is a composite number, and thus the rule is found to be false.

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* Published by the Society for the Diffusion of Useful Knowledge.

From the account here given of the nature of physical investigation, as consisting in the ascertainment of the connection of causes and effects, and concomitant circumstances, the business of the philosopher seems reduced to a patient and diligent observation of nature, either in her spontaneous operations, or in such as he himself induces, by bringing substances into novel combinations.

The great error of the early philosophers was an indulgence—often an unconscious one—in suppositions and assumptions,—the error of fancying qualities in natural objects; of supposing them to exist instead of ascertaining whether they do or not; of assuming events to take place which never occur, and phenomena to be alike when they have no resemblance, or to be more alike than they really are. All these are, in fact, cases of what, in philosophical language, is dignified with the name of hypothesis, although that name is often restricted to the systematic explanation of phenomena on some principle consciously and professedly assumed.

It is in avoiding the faults here described, that modern philosophers are so much superior to those of former times. In the present day no event or circumstance, which is made the basis of any conclusion, or assigned as the cause of any phenomenon, must be assumed or conjectured, except provisionally; it must be witnessed or experienced: a conjectural fact is or ought to be sternly refused admission. This is a rigid consequence of the truth before-mentioned, that we can know nothing of an object but what we have learnt through the organs of sense,—nothing of the operation of a cause but from having seen the effect,—nothing *a priori;* and, consequently, our business is to observe, not to assume the existence of qualities or events which have never been perceived or experienced.

The latitude of conjecture and assumption of imaginary facts, to be found in the writings of men of science, not many hundred years ago, is truly amazing to any one accustomed to the more rigid habits of modern times. Just and comprehensive as many of Lord Bacon's views were on the methods of investigating nature, yet even his writings abound with instances of gratuitous hypotheses and assumptions, which would scarcely be tolerated at present in the productions of a mere novice. As an example, take one of what he calls his "experiments in consort touching sleep." "Those that are very cold, and especially in their feet, cannot get to sleep: the cause may be, for that in sleep is required a free respiration, which cold doth shut in and hinder; for we see that in great colds, one can scarce draw his breath. Another cause may be, for that cold calleth the spirits to succour; and therefore, they cannot so well close and go together in the head, which is ever requisite to sleep."

Here are a whole string of absolute fictions,—the existence of certain ethereal substances termed spirits, the calling of these spirits to succour, their closing and going together, and the necessity of this going together to produce sleep; and these mere fictions are assigned as an explanation of the phenomenon to be accounted for.

Again, in speaking of fragile bodies, he says, "Of fragility the cause is an impotency to be extended, and, therefore, stone is more fragile than metal." "And the cause of this unaptness to extension is, the small quantity of spirits; for it is the spirit that furthereth the extension or dilatation of bodies; and it is ever concomitant with porosity, and with dryness in the tangible parts: contrariwise, tough bodies have more spirit and fewer pores, and moister tangible parts." Here, again, the same mere hypothetical substance, which he terms spirit, and of the existence of which there is not the slightest evidence, is assigned as the cause of the effect described.

These occult qualities or substances, termed spirits, were in great request with philosophers, in their attempts at accounting for events. Malebranche, in his "Search after Truth," affords a remarkable instance of it. After observing how fond men were of supporting the most evident propositions by quotations from their favourite authors, he proceeds: "All this is occasioned by reason that the traces imprinted on the fibres of the brain by the objects of their prepossession are so deep, as always *to remain gaping and half-open; and the animal spirits, continually passing through them, preserve them so without permitting them to close again.*" I need not point out, in this passage, the series of imaginary events produced as an explanation of a real event.

Lord Bacon, in another passage, which he entitles "Experiment solitary, touching the nature of air," presents us with an additional instance in point: "Star-light nights, yea, and bright moonshine nights, are colder than cloudy nights. The cause is, the dryness and fineness of the air, which thereby becometh more piercing and sharp." "Also, close air is warmer than open air, which, it may be, is, for that the true cause of cold is an expiration from the globe of the earth, which in open places is stronger."

I have selected this passage for quotation, because, although it shows considerable sagacity, it not only exhibits, like the others before cited, the inveterate habit of assuming fiction for fact, common in that age, but affords an opportunity of presenting a striking contrast in the state of knowledge on this subject, then and now.

All those who are acquainted with Dr. Wells's celebrated work on Dew, know very well that clear star-light nights are colder than cloudy nights, because, in the former, the heat of the earth is radiated into space, while in dull nights, it is arrested by the clouds, and radiated back to the earth. In fact, therefore, instead of there being an expiration of cold from the earth, there is an efflux of heat. The theory of Dr. Wells was established by a series of patient experiments, and is consistent with all our other knowledge on the subject of heat. It shows us what really takes place, viz., that the earth becomes colder by radiation; and that the air in contact with it, losing part of its heat by communication, suffers in consequence a diminution in its capacity of retaining water in solution, and deposits its redundant moisture in the form of dew.

If Bacon, with a strong although not well defined sense of the true method of physical investigation, fell into gratuitous assumptions of this kind, it is scarcely surprising to find similar trespasses in Aristotle. This last-named philosopher asserts, that if two different masses of the same material were let fall from the same height, the heavier mass would reach the ground sooner than the other, in the proportion of their weights,—ten pounds, for example, ten times sooner than one pound. Nothing can more strikingly show than this assertion how strong was the propensity amongst the philosophers of former days to substitute mere suppositions and conjectures for facts;

for here there was no difficulty. The proof, whether this was a law of nature or not, was of the simplest and most direct kind; and yet Galileo is said to have been the first philosopher who thought of making the trial. He performed the experiment at Pisa, from the summit of the leaning tower there; but even then, the followers of Aristotle seem to have preferred the *dicta* of their master to the testimony of their senses.

The assumption of fiction for fact is often the assumption of some analogy which does not exist. The meaning of analogy is resemblance, and hence all reasoning from one case to others resembling it might be termed analogical; but the word is usually confined to cases where the resemblance is of a slight or indirect kind. We do not say that a man reasons from analogy when he infers that a stone projected into the air will fall to the ground. The circumstances are so essentially similar to those which have been experienced a thousand times, that we call the cases identical not analogical. But when Sir Isaac Newton, reflecting on the tendency of bodies at the surface of the earth to the centre, inferred that the moon had the same tendency, his reasoning in the first instance was analogical.

By some writers the term has been restricted to the resemblance of relations: thus, knowledge is said to bear the same analogy to the mind as light to the eye—to enlighten it. But although the term is very properly applied to this class of resemblances, I think it is not generally confined to them; it is commonly used with more latitude, except, indeed, in mathematics, where it is employed to designate the identity of ratios.

The great practical faults to be avoided are fancying resemblances, and where they are real neglecting the differences, dwelling only on points of similarity, and forgetting that in exact proportion as the cases differ our inferences from one to the other become uncertain. There have been some curious instances in the early ages of philosophy, of wonderfully ample conclusions from analogies of the slightest and sometimes of the most fanciful kind. Thus one astronomer contended that the number of planets must be necessarily seven, because, to use his own language, "there are seven windows given to animals in the domicile of the head, through which the air is admitted to the rest of the tabernacle of the body, to enlighten, to warm and nourish it, which are the principal parts of the *μικροκοσμος* (or little world)—two nostrils, two eyes, two ears, and a mouth; so in the heavens, as in a *μακρακοσμος* (or great world), there are two favourable stars, two unpropitious, two luminaries, and Mercury alone undecided and indifferent. From which, and many other similar phenomena of nature, such as the seven metals, &c., which it were tedious to enumerate, we gather that the number of planets is necessarily seven."

It was a very common proceeding to explain physical effects by fancying an analogy between them and the actions of sentient beings. Thus water would not rise higher in a pump than thirty-three feet on account of Nature's horror of a vacuum. Kepler, that great astronomer, who has been termed the legislator of the skies, seriously attempted to account for the motions of the planets by supposing them to be gifted with minds capable of finding their way through the pure undistinguishable ether, and of making constant observations on the sun's apparent diameter, in order to regulate their motions, so as to describe areas proportional to the times.

It has been well remarked that in the present day, when there is so great an accumulation of facts, the danger of being seduced into hypotheses, in the explanation of phenomena, is much diminished. In truth they can be mischievous only when they are taken for what they are not; when they are assumed as facts and rested in as the final port to which our voyage of discovery has been directed. While pursuing his inquiries, indeed, every man must necessarily form to himself certain suppositions which he proposes to bring to the test of experiment or of the observation of spontaneous phenomena; and till he has succeeded in bringing them to this test, they serve to give precision to his aim and unity to his efforts, and often lead to discovery of truth, even when erroneous in themselves. "It is not to be questioned," says Sprat in his "History of the Royal Society," "but many inventions of great moment have been brought forth by authors, who began upon suppositions, which afterwards they found to be untrue. And it frequently happens to philosophers as it did to Columbus, who first believed the *clouds* that hovered about the continent to be firm *land.* But this mistake was happy; for, by sailing towards them, he was led to what he sought; so by prosecuting of mistaken causes, with a resolution of not giving over the pursuit, they have been guided to the truth itself." The principal danger now is not from professed hypotheses, but from the practice of unconscious assumption before described; and even this, at least in physical science, is fast dwindling away, although it still largely vitiates mental philosophy, and especially the philosophy of the senses. The great point in these, as in other matters, is to regard every thing as what it truly is, and put it to its proper use—not to discard it because it may be misconceived or abused. Thus we are not to renounce what Milton calls the liberty of unlicensed printing because it has been used in the promulgation of mischievous works, when it has so largely contributed to the promotion of science, virtue, and happiness; but we must expose their character through the same instrumentality. We are not to despise a little knowledge (which we must inevitably submit to have before we can obtain much), but be perfectly conscious of its littleness;—and in the same way we are not to dismiss the aid of hypotheses because they have sometimes been put forth as facts, but be fully aware of their character, and suffer them to lead us *on* without leading us *astray*.

The representations which I have now given of the business of the inquirer into nature, and the principles of investigation, will assist us, I hope, in forming a clear conception of a process the nature of which is often obscurely or vaguely apprehended—the process of explaining or accounting for a phenomenon. In treatises on physical science these expressions are perpetually occurring, but they are frequently used in a way which betrays the absence of a just appreciation of what the terms imply.

By the expression, explaining how a phenomenon is produced or accounting for it, nothing in fact can be meant but what I have already described as forming part of the inductive process. It consists either in referring a phenomenon to a general law, or specifying some circumstance as the proximate cause of a phenomenon. As an example of the first case, take the law of gravitation. Were it to be asked, how are we to account for a stone falling to the ground? the inquiry would be satisfied by saying that it was owing to the law of gravitation, by which all bodies mutually tend to each other. And the deviation of a pendulum from the perpendicular near a large mountain would be accounted for on the same principle. In these cases it is obvious that accounting for or explaining a phenomenon is nothing more or less than stating a general law under which it may be classed. If any one still asked, how do you account for bodies gravitating to each other? the inquiry could be answered only by mounting up to some still more general law: and such is the propensity of the human mind to push its inquiries in this way, that even Newton himself, in one of his queries, hazarded the suggestion whether gravitation might not be owing to a subtile ether pervading all space. But even if the existence of such an element were established, the inquiry would remain, how do you account for a subtile ether operating in this way? how could it cause solid bodies to approach each other?

In the second case of accounting for a thing, we specify some event which comes between two known phenomena, one of which follows the other.

Thus, if any one were to ask, how do you account for our seeing external objects when we open our eyes? it might be answered,—rays of light from the object enter the eye. But how (continues the inquirer) do you account for the circumstance of rays which enter the eye producing a perception of the object? Answer: They are converged by the lens of the eye, and directed upon the retina, where they form a picture of the object from which they proceed.* But, once more, how do you account for a picture formed on the retina being followed by a perception in the mind ? Here probably we must stop, as we cannot specify any other event which intervenes between the impinging of the rays on the retina, so as to form a picture there, and the mental impression. But suppose we were enabled to say that a vibration is communicated along the optic nerve to the brain, we should still come to the inquiry, how do you account for a vibration communicated to the brain producing a perception of the external object ? Proceed as far as we might, we should still arrive at two events between which it would be the unavoidable tendency of our minds to suppose something intervening—a something the mention of which we should regard for a time as an explanation of the effect. These two kinds of explanation, which it is useful to distinguish, although by a further analysis they might be reduced into one, comprehend, I believe, all that we can do in the way of accounting for physical phenomena; they embrace, indeed, unless I am much mistaken, all that we can clearly conceive as appertaining to that process. To suppose, with some philosophers, that we can do any thing more—that we can ever find out or prove one event to be the necessary consequence of another, in the same way that we can demonstrate the equality of the angles at the base of an isosceles triangle to be a necessary consequence of the equality of the two sides, would be to indulge in a vain and a misleading anticipation, and to confound, not only two very different meanings of the word consequence, but two very different kinds of evidence.

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* See Dr. Brown's Seventh Lecture on the Philosophy of the Human Mind.

All the explanations ever given by philosophers, all the theories ever invented to account for the phenomena of nature, all the systems constructed or principles developed to show how events are produced, from the Newtonian law of gravitation wheeling the planets in their orbits, to the theory of the formation of dew on the grass, have never done more than point out resemblances between phenomena, or trace the order in which they occur. This is the simple character of our knowledge of the changes in nature; and let us proceed ever so far, adding fact to fact, and discovery to discovery, this is the character which our knowledge, as far as we can at present see, must always retain.

DISCOURSE VII.

ON THE MECHANICAL CAUSES OF THUNDER.

ACOUSTICS, or the doctrine which explains the subject of sound, has been beautifully illustrated within a recent period by the experiments of Savart, Wheatstone, and others. It is a subject naturally interesting to every one, embracing as it does the consideration not only of every variety of ordinary or unmusical sounds, but also of melody and harmony, which contribute so greatly to the exhilaration of human life.

It is not, however, the general subject which I now intend to treat, but merely the production of that particular sound, or combination of sounds, which we designate by the term thunder. To the consideration of this point I was led by a recent discussion amongst the members of the Society I have now the honour of addressing, in which it was contended that the proximate cause of the thunder-clap is the production of a partial vacuum or rarefaction of the air by the heat of the electric fluid.

You are all acquainted with the mode in which sounds are produced and conveyed through the air. Generally speaking, they originate in the motions of some solid substance, as in the vibrations of chords or of metals, or in the collision of one solid body with another; but the sounds we have to consider are, or may be, due solely to imponderable and aerial fluids. In the production of thunder, the only bodies necessarily concerned are the electric fluid and the atmosphere.

In the case of fluids, however, as of solid substances, there is no sound produced without the impact of one thing upon another, or, in other words, without two things being brought into contact with some degree of force; and if this is true, thunder must result either from the collision of two portions of air with each other, or from the impact of the electric fluid upon the air, or from both causes combined.

When a report is occasioned by air rushing into a vacuum, it is manifest that adverse currents of air strike against each other. Air might rush on for ever without noise if it met with no opposing body; and the only opposing body which is encountered by a portion of air rushing into a vacuum formed in the atmosphere, is another portion of air. Such an aerial collision is doubtless one of the mechanical causes of thunder.

But if two portions of air brought into instantaneous collision with each other occasion a loud report, there appears to be no difficulty in conceiving the electric current itself to produce a similar report when it instantaneously strikes the air.

Indeed it seems impossible to suppose that it should not do it. Whether we choose to consider electricity as a distinct fluid or not, it is quite clear that when a discharge takes place between two bodies through the air, a great force is exerted by some material substance, sufficient, in many cases, to split asunder the oak of the forest. Even by a common discharge from a battery you may drive a hole through paste-board, and if you present your knuckles to a Leyden phial, you will feel the spark as well as hear it. Now this force striking the air must necessarily produce a sound just in the same way as any substance sharply striking it produces one. The crack of a whip, the whistling of a bullet, and the rush of steam or of a sky-rocket, may be cited as instances. But the nearest example for our purpose is the explosion or detonation of solid substances—such as gunpowder.

The report arising from the ignition of gunpowder is owing to the gases (carbonic acid and nitrogen*), into which the powder is converted, suddenly striking the air with great violence. If the explosion takes place in a confined chamber, as the barrel of a gun, the noise is of course louder because the resistance is greater. Some part of the effect may possibly be due to the sonorous material of the inclosing tube; but the sound of an explosion in the open atmosphere (which is all that needs to be here considered) can be attributed only to the impact of the resulting gases on the air. So in the case of an electric discharge, a report is produced by the impact of the electricity on the same elastic medium. We have then before us two causes which may be concerned in the production of thunder,—the air rushing into a partial vacuum, and the impact of the electric fluid upon the atmosphere.

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* Berthollet found the elastic product to consist of two parts nitrogen gas and one carbonic acid gas.

It remains for us to consider how the vacuum is produced; and it will be found, I apprehend, to be mainly occasioned by the electric fluid forcing the air asunder as it passes. Some part of the effect may possibly be due to the rarefaction or expansion of the air from the heat of the electricity; but air is very moderately expanded by heat. If 1000 cubic inches of air at the temperature of 32° of Fahrenheit were raised to 212°, they would be expanded to no more than 1376 cubic inches.

We can scarcely, then, regard the heat communicated to the air by the electric fluid as adequate to produce the effect to be accounted for, and we are obliged to resort to the direct effect of the disparting force of that fluid.

Should it be objected that a vacuum could not be produced in this way, I beg the objector to consider that the electric fluid while passing through the atmosphere must occupy space; that from its perforating non-conducting substances, it evidently does not glide unresisted through their pores; that it therefore does not dart through the atmosphere without exerting a force upon it, but displaces the air or cleaves it; that, on reaching the conducting body to which it directs its course, it is lost in that body, and no longer occupies space in the atmosphere,—whence it is plain that a vacuum must result.

The sudden extinction of a body occupying space, or the sudden solidification of an elastic fluid, could not manifestly, under any circumstances, take place without the production of a vacuum. As an illustration of this point, take the instance of a cannon-ball passing through the atmosphere. Why, in this case, is no vacuum occasioned? The air is forced asunder, just as it is in the case of an electric discharge; and the reason that no vacuum is produced is that the ball, constantly pressed by the air, remains at the end of its journey occupying the same space as it did through the whole of its course; whereas, in the case of an electric discharge, the electric fluid emerges from a condition in which it does not occupy atmospherical space into a condition in which it does, and, after rending asunder the air, sinks again into the state from which it had emerged. It may possibly be objected, that although the electric fluid cleaves the air, and by so doing forms a vacuum, yet, being imponderable, it probably effects this without itself occupying space. How one thing, however, can strike and push aside another and become visible, without itself taking up any room, is to me inconceivable.

That, in the case of an electrical discharge, *something* instantaneously takes up more room than was before occupied by the medium through which the discharge passes, was beautifully proved by the experiments of Beccaria. Into the mouth of a small ivory mortar, with a cavity an inch deep, and half an inch wide, he fitted a cork cap so as to shut up the aperture without much friction, and having made the wires of his battery pass through the sides of the mortar, the shock sent through the wires, suddenly acting upon the air in the cavity, forced out the cork with considerable violence. This effect admits of two explanations: it may be ascribed to the sudden expansion of the air by heat; or, more correctly, as I think, to the compression of the air by the shock; in other words, to the air being violently driven against the cork by the sudden impact of the electric fluid.

The hypothesis that the vacuum in such cases is produced by the electric fluid forcing asunder the air occurred to me on first considering the subject without recollecting the current doctrine on this particular point. I have since had the satisfaction of finding the same view succinctly expressed in a recent treatise on the Electricity of the Atmosphere. "When," says the writer, "the electricity has passed, the air, which had been forced asunder, again rushes into the partial vacuum, and gives rise to thunder or the report which follows the discharge." *

Here, it will be seen, the author ascribes the whole thunder-clap to this origin, while, according to my view of the subject, the clap is composed of two separate sounds falling on the ear at the same moment, the one sound arising from the stroke of electricity upon the air, the other from the collision with each other of portions of air rushing into a vacuum produced by the electric fluid.

What I suppose to take place would take place in an explosion of gunpowder if the gases instantaneously formed were as instantaneously condensed again into a solid substance. The report attending the explosion would then be compounded of the sound produced by the impact of the gases upon the air, and of the sound produced by the collision of adverse portions of air rushing into the vacuum formed by the condensation of the gases; but, from the instantaneousness of the whole process, these sounds would be heard as one. Actually, however, as I have already stated, the report from the ignition of gunpowder is exclusively due to the stroke of the suddenly formed gases on the air. An instance of a report from the reverse process is furnished by the sudden condensation of a mixture of oxygen and hydrogen gases into water.

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* Companion to the Almanac, 1839.

There are several other circumstances to be taken into account as giving some of its peculiar character to thunder. The original sounds are probably reverberated, sometimes from the clouds and sometimes from the earth. But a more influential circumstance is, that the reports from different points in the track of the lightning reach the ear, not at once, but in succession.

Sound, as we all know, travels much more slowly than light, and it travels, also, much more slowly than the electric fluid. If we suppose a flash of lightning to pursue an uninterrupted track receding from the place where we stand, as its passage would be almost instantaneous, the report must be equally instantaneous along the whole line; but the sound from the different points of the line not falling on our ears at the same moment, we should hear a prolonged peal instead of an instantaneous clap.

Such appears to me to be the true theory of the production of thunder considered as a sound. Different views will probably be taken of the mode in which the vacuum, that constitutes so important a part of the process, is formed; but, whatever opinion may be entertained on this point, it will still be a correct account of the causes of thunder to say, that the sound is owing jointly to the impact of the electric fluid on the air, and to the rush of the air into the vacuum which the passage of the electric fluid occasions; in addition to which there is of course, on many occasions, the sound arising from the impact of the lightning on the solid substances of the earth.

In closing my discourse, it may be well, by way of apology for one of its features, to mention, that its brevity is owing to an arrangement between another member of the Society and myself, by which, instead of either of us occupying the whole evening with one long dissertation, each undertook to furnish a short essay. Thus restricted, I found it expedient to confine myself to the elucidation of a single question amongst the many interesting topics presented by the science to which it belongs.

DISCOURSE VIII.

ON THE PARADOXES OF VISION.

Amongst the difficulties connected with the physiology of vision, there are several of an interesting character; and, amongst these, there are two especially which have for a long period excited discussion and controversy, without having been hitherto settled or solved to general satisfaction.

These, in the brief but inexact language usually employed, are described as erect vision with inverted images, and single vision with two eyes.

It is well known to all who have the slightest knowledge of Optics, that the images or pictures painted on the retina are inverted, and that, when we see an object most perfectly, there is a picture of it in each eye, although the object is seen single.

The difficulties presented by these facts, which had formerly engaged the curiosity of philosophers in no ordinary degree, seem to have been neglected for an interval of some years, till attention was not long ago recalled to them by Mr. Wheatstone, Mr. Whewell, Sir D. Brewster, and others.

Mr. Wheatstone, in a very interesting and original paper in the Philosophical Transactions on

Binocular Vision *, has brought forward a number of striking facts bearing on the second question, which have placed it in quite a new light.

To these, and to some inferences flowing from them, which appear to me to have been overlooked, I shall hereafter more particularly call your attention.

Mr. Whewell, in his able work on the "Philosophy of the Inductive Sciences," has discussed both of the difficult questions before us. He terms them the Paradoxes of Vision, and has treated them and some kindred topics, if not with all the exactness desirable, at least with a free and powerful pen. Like every other writer of any celebrity, he soon found antagonists to contest some of his positions. His treatise had not been long published before the "Edinburgh Review" took him roundly to task, and went pretty largely into the discussion of these and collateral inquiries. I have no information at all as to the authorship of the article referred to, which appeared in the number for January last †; but, from internal evidence, there can be little hesitation in attributing it to one of the most distinguished men of science in Scotland.

The two paradoxes of vision (to adopt Mr. Whewell's convenient phraseology) having been thus recently brought before the great philosophic world

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* Philosophical Transactions, 1838, p. 371.

† No. 152. January 1842.

by writers of so much ability, it occurred to me that a paper on the subject might possibly be interesting to our smaller sphere, especially as I conceive some of their explanations and arguments to be unsuccessful or erroneous; and that there is room for a completer solution of some difficulties, and a more accurate statement of others, than any which has yet appeared.

Although I cannot hope to make a discussion of so abstruse a nature intelligible to persons altogether unacquainted with physiological inquiries and metaphysical speculation, I flatter myself I shall be able to place the subject in a clearer light than that in which it has been hitherto exhibited to many of my auditors.

Let us, in the first place, consider the paradox of erect vision with inverted images.

The celebrated philosopher Kepler, although anticipated in some respects by Baptista Porta, has the credit of having first made the discovery, that inverted pictures of visible objects are painted upon the retina; and he showed from the principles of Optics how these pictures are necessarily formed in that position. The rays coming from any one point of an object, and falling divergently on the eye, are refracted by the cornea and crystalline, so as to unite again on some point of the retina, painting there the colour of that *point of the object* whence they come. As the rays from different points of the object cross each other before they arrive at the retina, the picture they form must be inverted.

Kepler's own explanation of seeing objects erect by means of inverted images was this :—As the rays of light cross each other, we conclude that the impulse we feel upon the lower part of the retina comes from above, and the impulse upon the higher part comes from below. Descartes afterwards gave the same solution; but it is obviously unsatisfactory, for the simple reason that it assigns an imaginary or fictitious circumstance as the cause of that which is to be accounted for. In point of fact, we feel no impulse, either on the upper or the lower part of the retina, and can therefore form no such conclusion as he states.*

It is astonishing to observe the answers which other distinguished philosophers have returned to this question.

Buffon, for example, says,—"The first great error in vision is the inverted representation of objects upon the retina. And till children learn the real position of bodies by the sense of feeling, they see every object inverted. . . . By the frequent handling of objects, they gradually learn they are neither double nor inverted; and custom soon makes them imagine they see objects in the order and position in which they are represented to the mind by the sense of touching."†

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* See Reid's Inquiry into the Human Mind, chap. vi. sect. 11.

† Natural History, Smellie's Translation, vol. iii. p. 3.

The same explanation has been adopted by Dr. Brown. That it is altogether incorrect, not to say absurd, will appear in the course of our remarks. At present it may suffice to observe, that the French philosopher is completely at variance with facts in asserting that children originally see objects inverted. In support of this assertion not a tittle of evidence has been ever adduced.

But if they really did see objects in that position, all the handling in the world would never make them see a single thing erect. There is no such power in any one of our senses to change the perceptions of another sense. A straight stick, with one end placed in a basin of water, would still appear to the sight to be bent at that end after a thousand proofs by the touch that it was otherwise.

I will not, however, detain you by a further account of the extraordinary explanations of eminent philosophers. All fallacies and absurdities on the subject will be best exploded by giving the true solution of the paradox before us, to which I will therefore now proceed.

The fundamental position on which the true explanation rests is, that the picture of an external object formed on the retina *is not seen.* There can be no doubt, that, whenever we see the object, a picture of it must be painted on the retina; but that picture is itself invisible to the eye in which it is formed. We see the object, not the picture;

and the presence of the latter in our own eyes can be nothing to each of us but a matter of inference. Myriads of the human race have lived and died without the faintest suspicion of their organs of vision being the constant theatre of such phenomena.

The bearing of these facts on the question before us is obvious. If they do not, accurately speaking, *solve* the paradox, they *dispel* it. For what is there of a paradoxical character remaining?

If we do not see the picture on the retina—if we are never conscious of the presence in our eyes of inverted or indeed of any other images,—what paradox is left to perplex the simplest mind?

The supposed difficulty was, "How is it that we see the object upright when the image is inverted?" and we may now turn round on the questioner and ask, "Why should the position of an image which is *not* seen, which is *not* present to our consciousness, regulate the apparent position of the external object which *is* seen? what difficulty is there to be explained in the fact that our perception of the position of an external object is not affected by the position of an invisible image?

It has, however, been maintained by eminent philosophers, or, what is the same thing, it has been implicitly assumed in their arguments, that we do actually see the images on the retina. Not to mention less eminent writers, Dr. Thomas Brown may be named as one whose mind was evidently imbued with this notion, for it is continually implied in his reasonings and language.*

Now, for the sake of argument, let us for the present grant the position of the philosophers referred to, and mark what follows. It will be easy, I think, to show that precisely the same results in point of perception must ensue. If we actually saw the *pictures* on the retina, instead of seeing, as we do, the *external objects* which they represent, we could not see a single point or line in any other position than that in which it actually appears. Nothing in any of those pictures could possibly be perceived as inverted.

This must be apparent to every one who reflects that seeing an object inverted implies seeing it altered in its relative position to something else: but every object in the picture retains its relative place. If it is the figure of a man, for example, in a standing posture, which is there depicted, the feet will appear nearest the ground and the head nearest the sky. Thus, as every point in the picture must preserve its relative situation to every other point, the whole field of vision can contain no one thing in comparison with which any other thing can appear inverted; and nothing except what is in the field of vision can be concerned in the comparison. This may be illustrated by the position of the building in which we are assembled, at two different hours, as midday and midnight.

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* Lectures, vol. ii. p. 86.

At midday it is in one position in absolute space, or in reference to any fixed point; at midnight its position is completely inverted; but as there is nothing to be seen in reference to which it is inverted, it cannot appear so to us. On a first view, it seems incredible that this conclusion should have escaped any of the philosophers who have speculated on the subject. But, I think, we may perceive the source of their error and perplexity. They have tacitly assumed that the spectator is, in some way or other, cognizant of *both* the image and the object.

Not, indeed, that they have consistently held to this duality of perception. They have sometimes spoken as if they considered the object alone to be visible, and sometimes the picture alone; but more frequently as if they conceived the eye to have the power of passing and repassing from one to the other, or of taking simultaneous cognizance of both, so as to bring them into comparison. From this unsteadiness and confusion of ideas, the paradox appears to have sprung. In order to see your way out of it you have only to avoid combining incompatible conditions. So long as you suppose that both the external object and the internal image are in the field of vision at the same time, or in close succession, or come and go by fits, and can be recognized by the eye as inverted in relation to each other, you may be perplexed to discover why the external object should appear upright, rather than the contrary; but keep consistently to one supposition, and you will be extricated from your perplexity.

If you suppose the *external object* to be the only thing seen (which is the real fact), then, as the image by the supposition is not in sight, there is nothing at all in the phenomenon to explain, no inversion to puzzle you, no contrariety to reconcile. If, on the other hand, you suppose the *image* alone to be visible, your perplexity will equally vanish; for the external object being by the supposition out of view, you have nothing in your field of vision in reference to which the image or any part of it can possibly appear inverted.

To persist in supposing both the object and the image in sight, is creating a paradox by your own confusion of ideas. So inveterate, however, is the notion of the pictures on the retina being visible, so pertinaciously does it cling to the mind, and even when it has been discarded so insidiously does it creep back into the thoughts, that two distinguished philosophers of the present day who expressly teach that these ocular images are *not* seen, give us explanations, as I shall by and by show, which are grounded on the assumption that they actually *are* seen.

There is yet another consideration which will elucidate the real state of the case. It is usually said, in explaining this subject, that we do not see the images on the retina, but we see by means of them. This language is employed by Dr. Reid in his valuable writings on the subject, and is adopted both by Mr. Whewell and by Sir David Brewster; but I think even this is going too far; in plainer terms, it is incorrect. The images are the necessary consequences or collateral effects of the means by which we see; not the means themselves. "They serve in no way," as Dr. Mackenzie well observes, "to produce perception, but are merely an invariable and necessary concomitant of vision. It is the impression made by the light on the retina which is the means of perception, and not the image." *

This point may be elucidated, perhaps, by a reference to the photographic process,—that most beautiful discovery of modern science. In this process we may note an optical and a chemical effect. When you admit the rays from any object into the camera, they both form an image on the prepared plate, and act chemically upon the surface of the plate. The latter effect corresponds in this comparison to the physiological impression made by rays of light on the retina. In both of the cases compared, the optical image is a necessary concomitant of what I here for distinction's sake call the impression. The image and the impression in both cases may be regarded as simultaneous effects produced by the incidence of the rays

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* The Physiology of Vision, by William Mackenzie, M.D., p. 229.

of light on the receiving surfaces. What is the nature of the impression thus made on the retina we are unable to say; it may be chemical, it may be mechanical or impulsive. The most probable supposition is, that the impression consists of a motion communicated by the rays of light to the expanded nerve; either to the matter of the nerve, or to some subtile fluid or ether contained in it. On the undulatory theory of light this conclusion seems to be unavoidable; but that theory itself, even if it were capable of explaining all the phenomena of colours, which no one, I believe, at present contends, has for its foundation two gratuitous assumptions,—1st, the existence of a luminiferous ether pervading all space and filling all the interstices of bodies; and, 2dly, undulations in this ether of inconceivable rapidity.

Now these, I apprehend, are not what Newton terms *veræ causæ;* that is, they are not matters of fact ascertained by our senses or our consciousness, nor necessary inferences from such facts; and therefore it appears to me that, however complete the explanations afforded by the theory may eventually prove, it can never rise higher than a probable hypothesis. Here, however, I am digressing from the question.

In the present state of our knowledge, the facts relating to this part of the subject of vision, stripped of all hypothesis, may be stated as follows, nearly in the words of an author already quoted:

— Rays of light from external objects passing through the pupil of the eye and falling on the retina, form there inverted images of those objects. Along with the formation of such images, which are themselves unseen, and not in any way the subjects of consciousness, "there is an impression of an unknown nature made on the retina, and by that impression we see." *

The preceding remarks have shown that in the exercise of vision we see the external object, and not the internal picture. Hence there is no more call upon philosophers to explain why we see objects erect (that is, as they are) instead of inverted, than there is to explain why we see a circle circular instead of square or octagon.

At the same time the mode in which the process is carried on may be worth adverting to, were it only to expose the incongruity of the doctrine taught by those writers who maintain that we originally see all objects upside down.

When any object is before the eye, rays of light, as we all know, proceed from the visible points of the object to the eye in right lines, and it is these rays which are the physical means of our seeing. That we see every visible point in the direction of the rays proceeding from it, within certain limits of deviation owing to refraction, appears therefore little short of a matter of necessity.

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* Physiology of Vision, by William Mackenzie, M. D., p. 12.

We see, for example, the visible points in the top of a candlestick by means of rays coming from them, and see them, consequently, in the direction of the rays: hence we must see the candlestick erect.

To suppose otherwise,—to suppose that we could see the candlestick inverted,—would imply that we could see the lower part of it by means of rays coming from the upper part; in other words, that we could see one object by means of rays coming from another.

It can make no difference in the force of this argument how the controversy may be decided which has been raised as to the precise direction in which every point is seen, or what is termed the law of visible direction. It has been denied that a point in an object is seen in the direction of a ray proceeding from it, and it is quite true that the visible point cannot be seen in the direction of *every* ray coming from it, because they come in different directions. Each visible point, in fact, sends forth a pencil of rays, which form a cone, having its base on the external surface of the cornea, and which, being again converged to a point, form another cone, the apex of which falls on the retina; the point of the object cannot therefore be ordinarily seen in the direction of the outer rays of the cone, but is seen in the direction, or nearly so, of the centre ray or axis of the cone.

This is the law of visible direction maintained by Dr. Smith and others. Sir David Brewster, following Kepler and Dr. Porterfield, maintains one somewhat different; namely, that a visible point whose image is formed on the retina, by rays proceeding from an external object, is seen in a direction perpendicular to the spherical surface on which its image is formed. A third statement of the law of visible direction is that of D'Alembert, who taught that every point in a visible object is seen in the direction of a right line joining the point with its image on the retina.

These three lines, however, nearly coincide, and, at all events, whichever is adopted, the argument I am here urging remains unaffected. All that I have occasion to contend for is the simple position, that as rays are the means by which we see any visible point, we must either see the point (whether strictly, or according to some law of deviation) in the direction from which the rays come, or see it without rays; *i. e.* without the means of seeing; or, lastly, see it by means of rays coming from some other point.

When we put together the considerations already adduced, that it is the object itself, not the image on the retina, which is seen; that the image, strictly speaking, is not even the means of seeing; that every point of an object is perceived by means of rays proceeding from it, and, consequently, in the direction of those rays, all rational inquiry seems to be satisfied.

We find that there is no reason why we should not see objects as we do, and that there is a reason why we should.

The inquiry, Why do we not see objects inverted? when it is reduced to precision, becomes, in truth, as I have shown, an absurd one. It is no less than asking why we do not see an object before us inverted, because another object out of view is inverted; and is about as rational as inquiring why our antipodes do not seem to themselves standing with their feet upwards. A learned physician might certainly have spared himself the attempt which he made some years ago to satisfy the inquiry, by showing the origin of the optic nerves to be such, that the filaments ending in the upper part of the retina come from the lower part of the corpora quadrigemina, and *vice versâ.*

All such attempts at explaining what requires no explanation, seem to spring from the error before noticed of supposing, with more or less unsteadiness and inconsistency, the picture on the retina to be *in sight*, whereas it is only *in the eye:* two very different things, although expressed by phrases apparently equivalent. On the same supposition, you may easily construct abundance of other paradoxes, and I am only surprised that they have not been brought forward. Thus, how is it that we see an arrow straight when its image on the retina is evidently curved? How is it that we see external objects at all, when the visual faculty, or percipient brain, or intelligent mind is at the *back* of the retina on which their pictures are painted, and must be supposed to be in the situation of a spectator looking on the back of a mirror?* How is it that we see objects a hundred or a thousand times larger than their images appear on the expanse of the optic nerve?

All these questions are just as rational as the inquiry respecting upright objects and inverted images, and they equally fall before the simple truth, that we see the objects themselves and nothing else.

We now come to the consideration of the second paradox of vision,—namely, single vision with two eyes.

When we look at any object with both eyes, the rays of light proceeding from it make two impressions, one on each retina. Either of these impressions alone would cause us to see the object; and when they are received by both retinæ simultaneously, they do no more. Under ordinary and natural circumstances, we equally see the object single, whether we look at it with one eye or both eyes.

Hence the question arises, How is it that we see only one object by means of two impressions?

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* A recent author, who modestly speaks of Locke's *trash*, must doubtless have forgotten this position of the brain when he penned the following exquisite passage:—"The retina is a little looking-glass, in which your brain perceives the pictures of surrounding objects, just as you perceive the picture of your face in your shaving-glass."

In treating the first paradox of Vision, I endeavoured to show that there really is no difficulty to be solved, and that every thing paradoxical disappears, when we come to reflect on the subject with precision. The second paradox, however, although some of the perplexity attending it has likewise been occasioned by confusion of thought, presents a real physiological difficulty or phenomenon to be accounted for, and that of a remarkably interesting character. We must first endeavour to clear away so much of the perplexity as may have arisen from incoherent thinking, and then the real nature of the difficulty will manifest itself. With this view, and in order to simplify the subject as much as possible, it is needful to distinguish between the case of distant objects and the case of near objects.

Objects, it is plain, may be so distant, that when we look upon any point in them with both eyes, the optic axes will be parallel, or so nearly parallel, that the deviation cannot be discerned. The stars, for example, are so remote, that when we look at any one of them, the axis of the right eye will be parallel with that of the left. But we need not soar into the heavens. The same remark holds good when we look at any remote object on the earth. In this case, it is obvious that an object must be seen single. It is a physical impossibility for it to be seen otherwise. Seeing an object double implies seeing it in two places; but if, as we are supposing, the axes of both eyes, when looking at it, are parallel, the left eye sees it exactly in the same direction or same place as the right. Unless, consequently, two objects could appear to occupy the same space, no more than one appearance can be seen.

Suppose a lighted candle to be the object, placed at the required distance. Whether we look at it with one eye or both eyes fixed upon it, we shall see it exactly in the same direction,—or, in other words, occupying the same position in space, or the same relative position to objects, at an equal or a greater distance. How, then, could the candle be seen double? If you maintain that it could, point out *where* the second appearance could possibly be seen by an eye whose axis was parallel to that of the other. Again, with regard to *all* objects, it is a physical impossibility that all objects could be seen double unless they appeared diminished one half in size. The field of vision is a definite space, and can hold only a certain number of objects of a definite size. How could two appearances of every object be crowded into it, if we suppose them to retain their magnitude? It makes no difference in this argument, that to each eye the field of vision is not exactly the same; that the left eye can see objects to the left hand which are not visible to the right eye, and *vice versâ*. There is a part of the field common to both. Now this part, also, is of a definite size; and the same diminution of appearance would be required to take place in it, on the hypothesis of a duplication of all objects. On looking at objects in this space with the right eye only, we should see a certain number of them, and each of them of a certain magnitude; on looking with the left eye only, the same; but, on looking with both eyes, as we must, by the hypothesis, see every object double, we must inevitably see either all diminished one half in size, or two objects occupying the same place.

Objects, no doubt, are sometimes seen double; but it is always by some unnatural effort or derangement of the visual apparatus; and such double, or rather second appearances, always prevent the view of other objects before visible, which could not happen *if all* objects were seen double. In that case, any such prevention would be impossible, or would involve a contradiction. There could be no place, consequently, for any second appearance to be seen in.

In discussing this question, the able writer of the article in the Edinburgh Review, to which I have already referred, has broached an extraordinary theory, which, as it is in direct opposition to what I have here advanced, I will briefly notice.

" The phrase," he says, "*single vision with two eyes* in a state of perfect action, is a most unphilosophical expression. Except when the nose or the brow obstructs the rays passing to one eye, *we always see double:* that is, two superposed images;

and these images appear single only when the corresponding lines of visible direction are directed to the object, or when, from some physiological cause, one of the images either disappears, or is not recognised by the mind.

"When we look through a parallel plate of quartz, we actually see two images of every object; but they always appear as one, from the feebleness of its double refraction. We can, however, separate them by turning the plate into a prism, just as we separate the two images in single vision by squinting or displacing one of the rays by pressure. The same is true if we had a hundred eyes. We should then see a hundred images all coincident, but all united into a single image by the convergency of the hundred lines of visible direction to the same point."* The critic afterwards adds, that by pressing the eye-ball, one of the images may be slipped aside from its superposition on the other.

Thus the reviewer, in fact, gets quit of the difficulty by denying the existence of the paradox. He contends that we *do* see double, but that we see one image superposed upon another,—a most extraordinary assertion, I must venture to say, with the utmost respect for his great services to optical science, and as incorrect as extraordinary.

As in the act of vision, the images on the two retinæ are the only images concerned, we are unavoidably led to ask, in what possible way can the image on one retina be placed over the image on the other? How can the left image be placed over the right, or the right over the left, when they are in reality, and must ever remain, as far apart as the two retinæ on which they are severally depicted? What real physical fact is described, when the reviewer tells us that one image is slipped aside from its superposition on the other by pressing the eye-ball? His expressions seem to imply that the images can be detached from the eyes, and (to use a bold figure) undergo a sort of manipulation by those organs.

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* Edinburgh Review, No. CLII. p. 282.

The marvel of such a doctrine being maintained is the greater, inasmuch as the reviewer, only a few sentences before, had concurred with Mr. Whewell and others in the proposition, that we do not see the image on the retina, but see by means of it; and yet it is obvious, that the very notion which he had thus discarded is implicitly assumed, and even expressly asserted, in his theory of superposition.*

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* In a recently published volume, entitled "Correspondence of Sir Isaac Newton, and Professor Cotes, &c., by J. Edleston, M. A.," there are some curious letters from Newton to Dr. William Briggs, who had produced "a New Theory of Vision" before the Royal Society, in which letters Newton appears to have forestalled the Reviewer in this matter. "Distort one eye," he writes, "and you will see the coincident images of the object divide from one another, and one of them remove from the other upwards, downwards, or sideways, to a greater or less

Let us next proceed to examine the case of near objects, by far the most curious and interesting part of the subject.

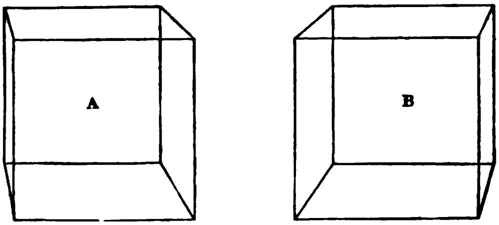
I have already had occasion to mention, that when we look with both eyes at an object so distant that the optic axes are parallel, we must see it in one and the same place, whether we look at it with the right eye or the left eye, or with both eyes at once. Hence, if the object is a solid, as a cube for example, the perspective appearance will be the same to each eye, and the same picture of it will be painted on the retina of each.

But this is no longer the case if the solid object is so near that when we look at it with both eyes the optic axes sensibly converge. Here it will be plain, on a little reflection, that according to the acknowledged laws of perspective, a different aspect will be presented to each eye by the solid object before it; or, to express the same fact in other language, a different perspective figure will be projected on the retina of each eye.

If a cube be held a few inches before the observer, and he view it with each eye successively

distance, according as the distortion is; and when the eyes are let return to their natural posture, the two images advance towards one another till they become coincident, and by that coincidence appear as one." (Page 267.) Afterwards, in the same letter, he modifies his doctrine, and talks of *motional* pictures in the *sensorium* coming together and becoming coincident (see page 269.): all which (*pace tanti viri*) is but assigning imaginary facts in explanation of real ones.

while the other is closed, he will at once verify this fact for himself. The two diagrams on the board, A and B, represent the two perspective projections of such a cube; A being the aspect of the cube seen by the left eye, and B being that seen by the right.



That two different aspects must be presented in this way may not only be proved by experiment, but necessarily follows from the established laws of perspective; inasmuch as the same object of three dimensions, when viewed first by one eye and then by the other, is seen from two points of sight separated by a distance equal to the line joining the two eyes.

It is a most extraordinary circumstance, that much as the subject of single vision with two eyes had been discussed by philosophers of the first eminence, this simple fact, so easy to observe and so plainly offering itself as an inference from well-understood laws, was passed by unnoticed till it was pointed out a few years ago by Professor Wheatstone. As far as my own reading extends, I can safely affirm that no previous writer on the subject had, with any sense of its value, distinctly adverted to it, although it is implied in a passage in Buffon*; and therefore I entertain no doubt of the justice of Mr. Wheatstone's claim when he says, that "the projection of two obviously dissimilar pictures on the two retinæ when a single object is viewed while the optic axes converge, must be regarded as a new fact in the theory of vision."†

The wonder is, not that Mr. Wheatstone should have made the discovery and have pointed out the fact, but that it should have been left for him to discover and point out.

The discovery of the bare fact, however, would have been little in itself. Although the phenomenon had never before been distinctly set forth, I have no doubt that the circumstances described by Buffon had been casually observed by thousands before Mr. Wheatstone's time, but without exciting any further thought. With them the observation had been fugitive and barren.

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* "It is equally easy to show that we see all objects double. If, for instance, we look at an object with the right eye, we will [shall] find that it corresponds with a certain point of the wall; if we look at the same object with the left, it then corresponds with a different point; and, lastly, when we look at it with both eyes, it appears in the middle between these points. Thus an image of the object is formed on both eyes, one of which appears on the left and the other on the right; and we perceive it to be single and in a middle situation, because we have learned to correct this error of vision by the sense of touching."—Buffon's Natural History, Smellie's Translation, vol. iii. p. 4.

† Philosophical Transactions for 1838.

But mark the train of original ideas which it suggested to the fertile mind of this distinguished philosopher.

The inquiry occurred to him, "What would be the visual effect of presenting simultaneously to each eye, instead of the object itself, its projection on a plane surface as it appears to that eye?" For example, what would be the effect of presenting the plane representation A of a cube to the left eye, and the plane representation B to the right, both at the same time?

Mr. Wheatstone tried the experiment, and the result was what his sagacity appears by the very institution of the inquiry to have foreseen. When two such perspective projections were thus simultaneously presented one to each eye, instead of seeing two figures he saw only one; and instead of seeing a plane representation of the object, as each drawing appeared when viewed separately, he saw a figure of three dimensions, the exact counterpart of the solid object from which the drawings had been made. The cube started from the paper into bold relief. Even in this age of admirable discoveries, this, I own, appears to me one of the most ingenious and beautiful that can be named.

That two flat diagrams should thus assume the appearance of a solid object in vivid relief, is most wonderful; and it is equally wonderful that it should enter the head of any man to try whether such would be the result. It shows a mind (to borrow the language of Shakespear), "apprehensive, quick, forgetive, and full of nimble shapes."

The discovery immediately threw a new light on some subtle questions. More especially by showing the perception of the three dimensions of space to be a simple and direct function of sight, it appears to me, as I have already stated in a recent publication *, to have at once experimentally subverted the celebrated theory of vision which was given to the world by Bishop Berkeley. With this question, however, Mr. Wheatstone, it may be necessary to state, does not meddle. In order to facilitate his experiments, which cannot be readily made without mechanical assistance, Mr. Wheatstone contrived an exceedingly ingenious, although very simple instrument, which enables any one to make them with perfect ease. This instrument he calls a stereoscope, from the Greek words *στερεος* solid, and *σκοπεω* I look at, indicating its property of representing solid figures. It is now on the table before you, very humble in appearance and simple in construction. The construction of it will be easily understood by inspection. It consists of two plane mirrors so adjusted that their backs form an angle with each other of 90°. These mirrors are fixed by their common edge against an upright board, cut away in such a manner as to allow the eyes to be placed before the two mirrors. The sides are two vertical boards, each placed at the same distance from the mirror opposite to it, and at an angle with the mirror of 45°, and each having grooves at the top and bottom into which the drawings may be inserted. The observer places himself with his eyes as near as possible to the mirrors, and if a pair of perspective drawings as before described have been properly fixed in the grooves, he will see a single figure in bold relief. If he now close either of his eyes, the appearance of relief will vanish, and a single plane drawing present itself.

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* A Review of Berkeley's Theory of Vision, designed to show the unsoundness of that celebrated speculation, p. 100.

It is to be observed that the instrument is made to present the reflected images of the drawings instead of the drawings themselves, in order to obtain a better light, and a larger field of view undisturbed by lateral appearances; an expedient which makes no difference in the experiments except requiring the right and left hand diagrams to change places. Time will not permit me to mention all the results of the experiments thus made, but I may just glance at some of the principal ones.

1. If two perfectly similar perspective drawings are placed in the stereoscope, instead of two varying in the required manner, a single figure will be seen, but without any appearance of relief.

2. If two similar objects of three dimensions are placed before the mirrors, so that they project precisely the same figure on each retina, a single plane figure is seen, just as if mere drawings had been placed in the stereoscope. In trying this experi-

ment Mr. Wheatstone employed two skeleton cubes formed of wire, and the compound appearance was that of an outline representation on a plane surface. When these cubes were so placed that the pictures which they projected on the two retinæ were the same as those which would have been projected by a single cube placed at the concourse of the optic axes, a cube in relief appeared before the eyes.

3. If the figures presented to the right and left eye differ in size within certain limits, there is still only a single resultant perception, but the binocular appearance will be intermediate in magnitude between the two monocular ones.

4. Most of these facts I have verified by my own experiments; but there is another interesting part of the subject, in regard to which the trials I have made do not correspond with those of Mr. Wheatstone: I allude to the subject of colours. "If a blue disc," says Mr. Wheatstone, "be presented to the right eye, and a yellow disc to the corresponding part of the left eye, instead of a green disc, which would appear if these two colours had mingled before their arrival at a single eye, the mind will perceive the two colours distinctly, one or the other predominating either partially or wholly over the disc." I have found, however, that although there is sometimes this alternation of colour when the pictures are held in certain lights, yet that in other lights I see a medium colour. A pair of drawings, one blue and one yellow, when placed in the stereo-

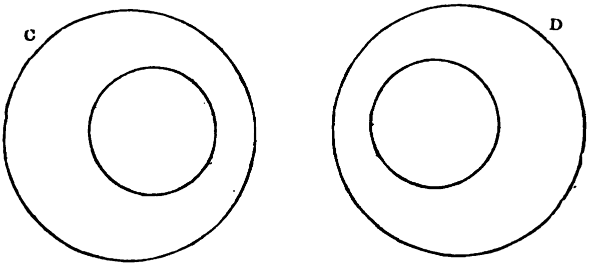
scope, produce a figure of a greenish hue. Red and yellow produce orange, red and blue violet. These intermediate or compound colours are not, it is true, very clear, or bright, or well-mixed, but still they are altogether different from those seen by each eye separately. On trying in the stereoscope a blue and a yellow diagram painted on common thin letter-paper, I found the resulting colour similar to that which was produced by placing one diagram over the other, and holding them up to the light.

The facts in binocular vision which I have now detailed to you as having been first brought to light by Mr. Wheatstone, manifestly place the question of single vision with two eyes on new ground, as far at least as it relates to near objects. Still, even in regard to near objects, it is necessary to distinguish two different cases.

When we look at a figure on a flat surface, as, for instance, the paper of a room, so near that the optic axes sensibly converge, we see only one figure with both eyes, and it is the same as that which we see with each eye separately. On each retina there is a precisely similar image depicted. This case, which, I think, is not adverted to by Mr. Wheatstone for explanation, differs from the case of looking at distant objects in the circumstance of the optic axes being convergent, not parallel; and it differs from the case of looking at near solid objects in the circumstance of the images projected on the wo retinæ being similar, not different. The same considerations which have been adduced to show that there is no *place* for a second appearance of distant objects seem applicable here. *Where*, it may be asked, could a second appearance of a figure on the wall of a room, whatever might be the convergence of the optic axes, be possibly perceived?

But let us turn to the more interesting case of looking at near solid objects. The difficulty is no longer simply how is it that we see an object single with two eyes, but how is it that, when we look at a near solid object with both eyes, we see neither the same aspect of the object as that which presents itself to the right eye alone, nor the same as that which presents itself to the left eye alone, nor yet these two aspects separate or intermingled with each other, but a single intermediate appearance—a third aspect.

To illustrate the character of the difficulty, let us take the two diagrams C D, which represent the two perspective projections of a truncated cone in outline. In looking at such a cone, placed at a



distance of a few inches before the eyes, we should see with the left eye the appearance represented by C; with the right that represented by D; but when we employed both eyes, we should see the outer and inner circles of the cone quite or nearly concentric, and the latter standing out from the former at a considerable distance.

The question to be solved, therefore, is, how the binocular perception of a single intermediate figure results from the monocular perception of two different figures.

In searching for a solution to this question, we should, in the first place, consider what sort of explanation we seek, or what sort the difficulty is susceptible of. By explaining a phenomenon is usually meant, the assignment of some general law or of some proximate circumstance on which it depends; and hence the solution of the difficulty in the present case might be attempted in three different ways; by assigning, namely, either an anatomical cause of the phenomenon, or an optical condition essential to it, or a psychological operation producing it. Could it be shown, for example, that there is a particular structure of the optic nerves adapted to produce the effect, the difficulty would be anatomically explained. Or it might be optically explained by showing that the phenomenon is dependent on the object being seen in a certain direction or plane. Or, thirdly, if I may venture on a rather extravagant supposition, an attempt might be made to explain it psychologically by tracing some act of comparison and adjustment by the mind itself, deliberating on the impressions received through each eye, and determining the form to be seen.

Of the first kind of explanation we are furnished with a specimen by no less a philosopher than Sir Isaac Newton himself, who made a strenuous effort to account for the general phenomenon of single vision with two eyes. With that true philosophic spirit, however, which led him to declare "hypotheses non fingo," and enabled him to discriminate with so nice a tact the actual from the hypothetical, at least in physical science, he puts his solution in the form of a query.

"Are not the species of objects seen with both eyes, united where the optic nerves meet, before they come into the brain, the fibres on the right side of both nerves uniting there, and after union going thence into the brain in the nerve which is on the right side of the head, and the fibres on the left side of both nerves uniting in the same place, and, after union, going into the brain in the nerve which is on the left side of the head; and these two nerves, meeting in the brain in such a manner that their fibres make but one entire species or picture, half of which on the right side of the sensorium comes from the right side of both eyes through the right side of both optic nerves, to the place where the nerves meet, and from thence to the right side of the head into the brain, and the other half on the left side of the *sensorium* comes, in like manner, from the left side of both eyes? For the optic nerves of such animals as look the same way with both eyes (as men, dogs, sheep, oxen, &c.) meet before they come into the brain; but the optic nerves of such animals as do not look the same way with both eyes (as of fishes and of the chameleon) do not meet, if I am rightly informed."

In some respects the substance of this query is correct. We are told by anatomists that immediately after the entrance of the optic nerves into the skull, and at the distance of about an inch and three quarters behind the eye-ball, the nerve from the right eye meets with that of the left. The inner halves of the two nerves cross each other; the inner half of the right nerve proceeding to unite itself with the outer half of the left, and the inner half of the left nerve with the outer half of the right, while the outer halves do not cross, but remain on each side of the point of union. To the crossing of the nerves here described has been given the name of *chiasma nervorum opticorum.* After this decussation and junction, the two new nervous combinations pursue their respective courses to their termination in the brain.

We may allow that this arrangement of the optic nerves may have something to do with the phenomenon to be explained; but still the dependence of one upon the other requires to be proved by more specific evidence. The peculiar manner, it may be added, in which the nerves decussate and unite seems to carry us little further than would the union of the nerves in the brain itself, or their termination in corresponding parts of it.

Besides this, it must be recollected that such explanations as Newton's have been produced simply to account for two *similar* pictures on the retinæ giving rise to the perception of a single object; and, even if admitted, they would still leave to be discovered what is that special arrangement in the structure of the nervous apparatus which we cannot help conjecturing must exist to cause our seeing one binocular appearance by means of two different monocular impressions received from the same object.

If the *chiasma nervorum opticorum* has any thing to do with the matter at all, of one truth we may be quite certain, that it does not perform the part assigned to it by Newton, who connects the anatomical facts with a psychological doctrine altogether groundless and imaginary. He speaks, as you will have remarked, of the species or pictures of objects being carried by the nerves to the brain, and even of half of a picture being carried by one nerve and half by another. Such were the traditionary doctrine and language of the times, from which even his great genius could not emancipate itself; but, as Dr. Reid has well observed, all this is mere hypothesis. "I am not conscious," adds he, "of any pictures in my *sensorium* any more than in my stomach."

The whole doctrine of images being conveyed by the nerves to the brain is an instance of an error very prevalent in these nice and difficult investigations, and against which it is necessary to be constantly on our guard; namely, assuming what are in reality mere figures of speech or fictitious circumstances, as positive facts in explanation of real phenomena, and reasoning upon them accordingly. One example of this kind I have already had occasion to point out, and another will almost immediately claim our attention.*

The query of Newton which has furnished occasion for these remarks may be taken as a sample of the attempts at explaining part of the difficulty before us by assigning an anatomical or physiological cause.

The second kind of explanation, namely, the assignment of some optical condition as essential to the effect, is the one that has been most generally attempted.

Several doctrines have been maintained on this head. One is, that we see single only when pictures, assumed to be similar, from the same object, are received on corresponding parts of the two retinæ; another, that we see an object single only when it is in what is termed the plane of the horopter; another, that we really make use of only one eye at a time.

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* See also the Discourse in the present volume, "On the General Principles of Physical Investigation;" and the last chapter of the author's "Theory of Reasoning."

It would be tedious to enter into these and other analogous theories, because they have in effect been set aside by Mr. Wheatstone's experiments; and those of my hearers who are curious to follow the track of error will find a close examination of them in his treatise, already referred to, in the Philosophical Transactions.

Moreover, like the anatomical explanation just examined, they relate only to the perception of a single object by means of two similar impressions, and do not touch the difficulty of two different impressions producing the perception of a single intermediate aspect of the object in view. Mr. Wheatstone himself has not hitherto propounded any solution of this kind, although he intimates an intention of doing so. "No doubt," he says, "some law or rule of vision may be discovered which shall include all the circumstances under which single vision, by means of non-corresponding points, occurs and is limited."

Of the third kind of explanation, viz. the psychological, I have met with only one instance requiring notice here; and this having been given to the public since Mr. Wheatstone's discoveries, it embraces the whole question as modified by them. It is contained in Mr. Whewell's "Philosophy of the

Inductive Sciences," and the passage in which it occurs is so singular an instance of speculation in the philosophy of mind, that I cannot resist the temptation to lay it before you.

"We have before," he says, "noted it as an important feature in our visual perception, that while we have two distinct impressions upon the sense, which we can contemplate separately and alternately (the impressions on the two eyes), we have a higher perceptive faculty which can recognise these two impressions, exactly similar to each other, as only two images of one and the same assemblage of objects. But we now see that the faculty by which we perceive visible objects can do much more than this; — it can not only unite two impressions and recognise them as belonging to one object in virtue of their coincidence, but it can also unite and identify them, even when they do not exactly coincide. It can correct and adjust their small difference, so that they are both apprehended as representations of the same figure. It can infer from them a real form, not agreeing with either of them; and a solid space, which they are quite incapable of exemplifying. The visual faculty decides whether or not the two ocular images can be pictures of the same solid object, and if they can, it undoubtingly and necessarily accepts them as being so. This faculty operates as if it had the power of calling before it all possible solid figures, and of ascertaining by trial whether any of those will at the same time fit both the outlines which are given by the sense." *

So far Mr. Whewell. Now, with a high respect for his general attainments in science, I cannot think that he has here done justice to his own principles of inductive inquiry. What can possibly be meant by our being able to contemplate the impressions on our eyes separately? and by our visual faculty recognising the two impressions as belonging to one object, and apprehending them as representations of the same figure? If, as Mr. Whewell had before taught, we do not see the pictures on the retinæ (which I presume he means by the term impressions, as he afterwards changes it for the phrase ocular images), how can we recognise them or apprehend them as representations of any thing, or indeed apprehend them at all? And how can we infer any third form from two other forms, the existence of which we are not aware of? How can the visual faculty decide whether or not the two ocular images can be pictures of the same solid object, when it cannot possibly perceive, or be in any way conscious of, those images?

It is manifest that by such language as this, by the terms contemplating, recognising, apprehending, identifying, and deciding upon these ocular images, and correcting and adjusting their differ-

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* Philosophy of the Inductive Sciences, vol. i. p. 288.

ence, no real facts are denoted. The operations are purely fictitious. Any real facts in the case must be either physical facts or facts of consciousness. Such phrases as are here commented upon cannot, of course, denote physical facts; and, as we are utterly unaware of any processes corresponding to them in our own minds, they cannot designate facts of consciousness. They are therefore strictly unmeaning, or expressive of imaginary operations.*

But it may perhaps be said, in reply, "there *are* two different pictures on the retinæ, and the visual faculty *does* combine them into one." There are no doubt two pictures, but as to the visual faculty combining them into one, this is a mere figure, amounting to no more than that we see only one object. The simple facts stated without figure are, that when we look at a near solid object with both eyes, we see a different aspect of it from that which presents itself to each eye separately. In the present state of our knowledge, we can perceive no circumstance in the structure of the organ, including the nervous apparatus (with, perhaps, the slight exception of the chiasma), on which this phenomenon can be supposed to depend; and as little can we find any peculiar optical conditions essential to it, or detect in our consciousness any intellectual process to which it can be ascribed. None of these things, at least, have hitherto been achieved, and we must therefore, in the modesty of true philosophy, admit the phenomenon to be at present, if not inexplicable, yet wholly unexplained.

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* The letter from Newton to Briggs, before referred to, seems also to have forestalled, in part, Mr. Whewell's mode of explanation. Speaking of the pictures on the retina he says, "those pictures transmit motional pictures into the sensorium in the same situation; and *by the situation of those motional pictures one to another, the soul judges of the situation of things without.*" — Correspondence, p. 269.

Of the two so-called paradoxes, then, which have engaged our attention, it appears that one arises entirely from vagueness of thought and confusion of ideas, and vanishes before a close inspection; the other may be divided into two parts, the first of which presents a fact which it seems impossible should be otherwise, while the second part is founded on a curious and interesting phenomenon, in which, till philosophers have been more succesful than hitherto in their attempts at explaining it, we may be contented to rest as a simple fact of perception, wonderful, it is true, but not really more wonderful than a thousand other phenomena which we are obliged to place in the same rank.

In attempting to give you a clear and succinct account of these questions, if I have not entirely succeeded, I have at all events taken you over some remarkable, although little-explored ground; which, whether you agree with me or not in my particular views, cannot fail to repay your transitory visit by the interesting character of its principal features.

[I may avail myself of the opportunity afforded by the publication of this Discourse, which was read in 1843, to offer a few suggestions in regard to the character of the difficulty presented for solution by Mr. Wheatstone's discoveries in binocular vision.

The difficulty is not, according to my view, how it is that we see a solid object to *be* solid by means of two different impressions on the retinæ. The perception of solidity is, it appears to me, as simple and direct a function of the organs of sight as the perception of colour, and, like the latter, is essentially the same with one eye as with two eyes. Being thus a simple perception, it neither requires nor admits of analysis or explanation. There can, of course, be nothing to explain in our perceiving an object to be solid with both eyes, if we see it solid with each eye singly.

Assuming this to be correct, the difficulty regarding solid objects is reduced to an inquiry as to the cause of our perceiving with both eyes an intermediate figure—a figure differing from each of those which are seen by the two eyes separately.

This is the only difficulty with really solid objects; but the stereoscope undoubtedly introduces another difficulty, why, namely, the perspective projections of a solid object on a plane surface should give the perception of solidity.

The latter difficulty, however, is quite apart from the other; and I should have been disposed to think it might be accounted for on the general principle that, when in two cases the nerves instrumental to perception are similarly affected, by whatever means, a similar perception will result, had it not been for the two cases of looking successively at a solid and at its projection on a plane surface with one eye. The retina, in these two latter cases, is as similarly affected as the two retinæ are when the actual solid and the two different plane projections are successively presented to the two eyes; and, consequently, the perception of solidity ought, on the principle mentioned, equally to follow in all these circumstances; but we know that it does not follow on the presentation of the plane projection to one eye.

If it did follow, there would be the anomaly of a single plane perspective figure appearing to us as a solid, when we used only one eye, and as a plane drawing when we opened the other, and used both eyes. So that on this account, as well as to prevent confusion between planes and solids in monocular perception, Nature (if I may venture on an allegory to explain my meaning) was under the necessity of arranging the optical apparatus in such a manner that we should see planes and solids with one eye as they really are. There was not the same necessity imposed upon her to prevent confusion between solids and their perspective representations to both eyes, as seen in the stereoscope, because such a deception of the sight could not be produced except through highly artificial means; although it is still a marvel that she should have left the door open for Professor Wheatstone to step in, and affect the retinæ by a most ingenious contrivance in a manner which she apparently never contemplated.

But to dismiss the allegory and to recapitulate what has been advanced.

The difficulties which now await solution appear to me to be two:—

1. The binocular perception of an intermediate figure when two different aspects of a solid are severally projected on the retinæ.

2. The binocular perception of a solid when two plane perspective figures are viewed in the stereoscope; and what may be called the converse case.

After this discourse had been written, I was favoured with a copy of a very ingenious paper by Sir David Brewster, which appeared in the Transactions of the Royal Society of Edinburgh, vol. xv., and in which, amongst other things, he endeavours to explain the difficulty of what, for shortness, may be termed the intermediate aspect of a solid viewed with both eyes. I speak with great deference, when I say that, notwithstanding the value of his remarks on other points, he has left this particular question where he found it. After very clearly describing the angles under which the sides of the frustum of a cone are seen respectively by the two eyes, he proceeds to say, "Hence it follows, that with both eyes we shall see the solid in perfect symmetry, with its summit C D concentric with A B" [its base]. This appears to me, I confess, leaping over the difficulty. In this description I can discover no *reason* why an intermediate aspect of the cone is seen : it is a mere statement of the facts of the case. He goes on to say, "and hence the reason is obvious why two dissimilar pictures in the retina give *a resultant picture* corresponding with the solid itself." Where, however, is this resultant picture formed? The writer surely does not intend to assert that a resultant picture displaces the two dissimilar pictures on the retinæ. The very difficulty to be accounted for, as I apprehend it, is, why two dissimilar aspects or perspective appearances of a solid, which project two dissimilar pictures on the retinæ should give rise, not to an intermediate picture on the retinæ (for the pictures there remain unaltered), but to the perception of an intermediate aspect by the mind.

I will take the liberty of remarking, too, that in several passages of this valuable paper, the pictures on the retinæ are spoken of as being visible, which much perplexes the explanations in which such language occurs.]

DISCOURSE IX.

ON THE THEORY OF WIT.

THE subject which I have selected for consideration this evening can scarcely be regarded as inappropriate to the present time. In the strenuous endeavours which, in this age of reading, are continually made to produce works of popular entertainment, no quarter of the intellectual world is neglected. The activity of literary enterprise, after expatiating largely in the regions of fancy and fiction, seems to have turned with new ardour to the fields of wit and humour. We are beset on every side with volumes of facetiousness and magazines of drollery. The merry tones of Theodore Hook and Thomas Hood yet linger on the ear, while Sam Slick shakes both sides of the Atlantic, and Punch disturbs the gravity of the world.

Our ancestors loved a jest well enough, as we see in the dramas of Shakespear and his contemporaries. Even Lord Bacon, who was himself highly endowed with the faculty of wit, did not think it beneath him to make a collection of remarkable sayings (put together apparently with great zest), and tells us that Julius Cæsar and Macrobius, " a consular man," did the same. Since then we have had a brilliant succession of witty writers in Butler, Dryden, Pope, Swift, Congreve, Chesterfield, Walpole and Sheridan, with countless others; but it would be difficult to find a period indulging so lavishly as our own times, in every kind and degree of the gay, the pungent, and the sparkling.

Some of our agreeable artists in this line assail the public with drollery in every form of verse, prose, and picture. They teach you the Latin grammar in a shower of puns, show you the day of the month in a flash of merriment, and illuminate the dismal vistas of history with all the variegated lights of facetiousness.

It has been objected, indeed, that this indulgence in the laughable is carried too far; that the matter, being overdone, degenerates into a melancholy affair; that the wearied sense of the ludicrous is brought to a ghastly smile. What eye (it is asked) can long endure a rapid succession of flashes? What mind does not tire of repeated shocks of surprise?

Wit and humour, it must be allowed, may be sometimes out of place, and sometimes carried to excess. This, however, is a liability which they share with other excellent things, and cannot be brought as a specific objection against them, although it may be against the works in which they appear. Enjoyment of every kind must, of course, have intermissions; and the more exquisite the pleasure, the more is a suspension required. We sicken at perpetual lusciousness: we loathe the unvarying atmosphere of a scented room, although "all Arabia breathes" from its recesses. "The breath of flowers," as Bacon beautifully observes, "is far sweeter in the air, when it comes and goes like the warbling of music, than in the hand." Even the rich illustrations which fancy scatters over the page of the orator or the poet, may be crowded on each other too fast. In eloquence, in fiction, in poetry, in every work intended to yield high and permanent pleasure, the body of the work must undoubtedly be something solid, something addressed to good sense or earnest feeling. The figurative decorations must appear no more than elegant foliage, or beautiful convolutions, surmounting the steadfast columns of thought and sentiment. Poets of mere imaginative power, however dazzling, who have not possessed considerable strength of intellect, have never been able to keep a high place in public estimation. For a while we are pleased to rise above the earth, and wing our way through the atmosphere of fancy; but we soon grow weary of an excursion which is all flight. In defiance of Bishop Berkeley, we must have a world of solid matter to alight and repose on.

Something of the same kind may be said of wit and humour. They have their times and seasons and appropriate places, and have need to be intermixed with less exciting qualities. Most effective when they take their turn with other good things, with simple narrative or pathos or reflection, it may be affirmed of them, as of the achievements of fancy, that their best specimens have a groundwork of good sense and substantial thought. And, after all, we need to be under no great apprehension of being satiated with facetiousness, since works of this class, in common with the dullest productions of the human mind, may be taken up and laid down at pleasure. You have always relief in your own power. Should you happen to meet with a connected tissue of wit in which almost every word is a sparkling point,—a piece of prose or rhyme in which one jest hands you over to another, and that to a third, and so on through the whole composition without pause or respite, till you feel insufferably dazzled by the incessant coruscations,—you have only to put the work aside, and retreat to the ready shade of your own thoughts.

The want of relief would be doubtless a defect in it as a work of art; but, if the lustre were genuine, the turns really happy, and the flashes brilliant, you would have small cause to complain, or rather, you might think yourself fortunate in being able to recreate your mind so delightfully at will.

One thing is manifest even from this little discussion, that wit and humour make a considerable figure in the world, and, like all other powers that exercise an influence on human affairs and contribute to human enjoyment, deserve to be investigated with closeness and accuracy.

Of these two qualities, which are usually treated together, I purpose, in my present discourse, to confine myself as far as practicable to the former, for the simple reason, that it will of itself furnish amply sufficient matter to occupy the time and attention of my audience.

"What wit is," says a celebrated author, "it may not be easy to define; but it is surely easy to determine that it is a quality immediately agreeable to others, and communicating, on its first appearance, a lively joy and satisfaction to every one who has any comprehension of it. The most profound metaphysics indeed (he continues) might be employed in explaining the various kinds and species of wit; and many classes of it, which are now received on the sole authority of taste and sentiment, might perhaps be resolved into more general principles."

The task which is so well marked out in this passage from Hume, I am now partially at least venturing to attempt.

Of the quality which is to form the subject of our inquiry, numerous definitions have been given*;

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* Some account of the various acceptations in which the term wit has been employed, appears in Discourse III. of the present volume.

but as it would be tedious to examine them here, I will proceed at once to state, explain, and support my own.

Wit may be described as consisting in an unexpected and ingenious combination of ideas of such a nature, as not to carry away the attention from the ingenuity displayed. A stroke of wit is a feat of intellectual dexterity occasioning surprise and admiration much of the same kind as those which are excited by exhibitions of sleight of hand, or by other performances in which muscular adroitness brings out unlooked-for results*; but its effects on the observer are far more liable to be enhanced by the operation of other principles, as I shall hereafter take occasion to explain.

To be witty, then, according to my view, a combination of ideas must be in the first place unexpected; secondly, ingenious; thirdly, of such a kind as not to withdraw the attention from the ingenuity displayed.

The first part of this definition or description will probably be received without cavil. The common language employed on the subject, the whole turn of our phraseology, the terms strokes, and sallies and flashes*, all point to the circumstance, that wit is something unexpected, something which causes surprise, something not obviously arising in the usual sequence of ideas. But, besides this quality of unexpectedness, there must be a combination of ideas of that peculiar kind which we call *ingenious*. A man might present to our minds an *unexpected* combination of ideas, but unless it were also ingenious, it would not strike us as witty.

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* An author of no little acuteness styles a juggler a wit in things, and a wit a juggler in ideas. See the Four Ages, by Jackson of Exeter, p. 122. A similar remark is made by Dugald Stewart, Elements, vol. i. p. 305. And a comparison of feats of wit to juggling tricks, in respect of the delight produced, is thrown out by Barrow, in his celebrated Sermon on the subject.

An example occurs to me, which I have somewhere met with, and which may serve in default of a better to illustrate this principle. The question having been jocularly proposed in a mixed party, "When does a lady look most interesting?" and a grave man having answered, with solemn deliberation, "*When she is stealing*," every one looked surprised and perplexed; but, after he had completed the sentence, and the full reply came out, "*When she is stealing your heart*," there was a universal smile.

So far, however, it may appear that an ingenious mechanical contrivance might be termed witty on the same grounds; and it is not to be doubted that the pleasure yielded by a new and ingenious piece of mechanism is closely analogous to the pleasure afforded by a stroke of wit. The effect would be still closer if the mechanical contrivance, like the stroke of wit, appeared to be purely extemporal—invented at the moment—and not the result of premeditation. In this case, the whole difference in effect between the stroke of wit and the mechanical invention (cæteris paribus, *i. e.* supposing them both free from accessory circumstances calculated to enhance or lessen the effect) would be attributable to all that is implied in one being a combination of ideas exhibited through the medium of words, and the other a combination of actual objects or materials. To one who has reflected on the peculiar properties of language, in modifying our trains of thought as well as our feelings, this distinction will present itself as of some importance.

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* Campbell's Philosophy of Rhetoric, Book I. Chap. ii.

But my definition further requires (what is perhaps rather a necessary condition for the full effect of wit than one of its essential elements) that the combination of ideas presented to the mind shall not carry off the attention from the ingenuity displayed. The combination might be novel and ingenious; but if it opened to the mind views of high importance or of deep solemnity, we should not be impressed with the feeling of wit. Perhaps the celebrated epigram on Dr. Franklin may be regarded as an instance in point: *Eripuit fulmen cœlo sceptrumque tyrannis.**

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* Another may be found in Lord Bacon's assertion respecting Final Causes, which would be felt as very witty were it not for the serious character of the subject: "Causarum finalium in-

It is this circumstance too in which, generally speaking, mechanical contrivances differ as to the effect on the mind from ingenious combinations of ideas. The former usually carry forward the understanding to the use which is to be made of them, and our pleasure at the ingenuity displayed is modified and rendered graver by the importance of the invention, or altogether superseded by the interest we take in the results. When ingenious mechanical feats terminate in themselves, as we see them on the stage under the magic stroke of the harlequin's wand, the emotion of the spectator is closely analogous to the pleasure experienced from the intellectual feats of the man of wit.

If this theory of wit is correct, it will follow that the impression which any unexpected and ingenious combination of ideas makes on the hearer will depend not altogether on the absolute ingenuity displayed, but partly on the hearer's opinion of it. The pleasurable emotion produced by wit is, as we have seen, compounded of surprise and admiration;' and in the case of any given combination of ideas, whatever raises our opinion of the inventive faculty exercised will increase the emotion itself; or, in other words, cause the combination to appear more witty.

This I shall attempt to elucidate by an example. I borrow the illustration, although not the use I

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quisitio sterilis est et tanquam virgo Deo consecrata, nihil parit." Dugald Stewart thinks it open to the charge of levity.

make of it, from Miss Edgeworth's Essay on Irish Bulls.

"The protection," said an Irish orator, "which Britain affords to Ireland in the day of adversity is like that which the oak affords to the ignorant countryman, who flies to it for shelter in the storm; it draws down upon his head the lightning of heaven." This perhaps, will be scarcely felt as witty, because the serious truth or allegation will predominate over the sense of ingenuity displayed. Were that ingenuity in some way rendered more prominent, the simile would have the effect of wit. If, for example, an Englishman should boast of the shelter afforded to Ireland by the British Oak, and an Irishman should retort, "Aye, such shelter as the oak affords to the countryman in a storm, when it draws down upon him the lightning of heaven," this distribution of the matter, by enhancing the hearer's impression of the ingenuity displayed, although the ideas remained unaltered, would give to the comparison the character of wit. This is, in truth, an example of what has often been remarked, that the wit appears greater "when the original idea is started by one person and the related idea by another;"* which may be resolved into the general law above enunciated, that one of the elements of wit being the ingenuity displayed, whatever increases the sense which the hearer entertains of the ingenuity increases his impression of the wit uttered, and in reality enhances its quality.

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* Dugald Stewart's Elements, vol. i. chap. v. Quinctilian, in his chapter *De Risu*, remarks, "Sunt enim longè venustiora omnia in respondendo quam in provocando."

It will be observed that I have named unexpectedness first amongst the ingredients of wit, but of course the ingenuity displayed is simultaneous with it. Logically, indeed, the quality of ingenuity has the precedence, since it is not the unexpectedness that is ingenious, but the ingenuity that is unexpected. And it is truly the ingenuity which may be considered as forming the permanent element in wit; for after the surprise has vanished, after a brilliant repartee, for example, has become familiar to us, we may yet retain our admiration and our relish of it. It would be, therefore, correct to say, that unexpectedness is a necessary accompaniment of wit when new to us, but not indispensable, except as a reminiscence, afterwards. Ingenuity comes upon us at first in a flash of surprise: it is seen permanently in the light of admiration.

Such, according to my view of it, is the nature of true wit; but it would be a very imperfect explanation of the subject if I stopped here, without adverting to other qualities usually found in combination with it, and greatly enhancing its effects. Wit is seldom, indeed, exhibited in its pure state; and my theory of it would unavoidably appear defective and insufficient, if I did not show how it coalesces with other principles, from which it is essentially distinct.

In the first place it may be remarked, that wit is very commonly mixed with the ludicrous, although it is not in itself necessarily laughable. It was asserted by Lord Chesterfield, himself a proficient in the art of producing it, that true wit never occasioned laughter in any human being since the creation of the world. It must be owned, however, that as its essence is to give pleasure, so its tendency is to raise a smile, between which and a laugh it would frequently require a nice casuist to draw the line of demarcation. The general truth, nevertheless, to which Lord Chesterfield's remark points is indisputable, that strokes of pure wit create the lively animation manifested by smiles rather than broad and hearty merriment. Perhaps no one ever laughed at the description of Belinda in Pope's Rape of the Lock, although it is unquestionably witty:—

> "Bright like the sun her eyes the gazers strike,
> And like the sun they shine on all alike."

Nor perhaps did any one ever laugh at that passage in the Dunciad, where the satirist is speaking of the Lord Mayor's show, and the subsequent celebration of it by the city poet, Settle—a passage which was pronounced by Hazlitt, no mean judge, to be the finest piece of wit he knew of*:

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* Lectures on the English Comic Writers.

> "Now night descending the proud scene is o'er,
> But lives in Settle's numbers one day more."

Although wit is thus quite distinct from the ludicrous, they are obviously qualities which, when they come together, must be in harmony. As the tendency of the former is to raise a smile, it cannot fail to harmonise with what pushes that smile into a laugh; and amongst the causes which enhance the effect of wit, the union of the ludicrous with it is probably the most powerful and prevailing. In the majority of cases those combinations of ideas which are unexpected and ingenious, and therefore witty, contain also some laughable coincidence or incongruity; or the ideas themselves are of a ludicrous character. Wit is then said to be mixed with humour, into the characteristics of which I have not here time to enter, but which seems to me to consist in a combination of ideas or objects purposely presented to the mind*, which are laughable in themselves, or are made laughable by the mode in which they are presented. In the instances quoted from the Rape of the Lock and the Dunciad, the images presented have nothing about them ludicrous, and our smile is the consequence of the gratification we experience from an unexpected and ingenious combination of ideas, pleasing but not laughable.

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* It may be necessary to remark that the terms wit and humour are almost unavoidably used, like many other words, in both a subjective and an objective sense: we speak of wit, for example, as a quality of the man, and also as a quality of what he says: we call him witty, and we designate his conversation by the same epithet. In this discourse I employ the terms for the most part in the objective sense, or, in other language, to denote qualities in that which is the product of the mind. *Objective* is not, perhaps, here strictly applicable; but I can think of no phrase more appropriate.

Of the mixture of the witty and the ludicrous we have an example in a sarcasm of Curran, the celebrated Irish barrister, who said of a countryman of his at Cheltenham, remarkable for a habit of lolling out his tongue, that he was, doubtless, trying to catch the English accent.

The influence of the ludicrous in enhancing the effect of an ingenious combination of ideas, cannot, perhaps, be shown better than by the often-quoted simile of Hudibras: —

> "The sun had long since, in the lap
> Of Thetis, taken out his nap,
> And like a lobster boil'd, the morn
> From black to red began to turn."

This is usually cited as an instance of wit, but that it owes its effect not so much to the ingenuity as to the ludicrousness of the comparison, will be seen by contrasting it with a passage from Lord Byron, which resembles it in the circumstance of likening the changes in the sky to the variations in the colour of a fish. Speaking of the deep-dyed Brenta at the close of a brilliant day, the poet describes it as

> "Filled with the face of heaven, which, from afar,
> Comes down upon the waters; all its hues
> From the rich sunset to the rising star,
> Their magical variety diffuse:

And now they change; a paler shadow strews
Its mantle o'er the mountains; *parting day*
Dies like the dolphin, whom each pang imbues
With a new colour as it gasps away,
The last still loveliest, 'till—'tis gone—and all is gray." *

The comparison here is quite equal in point of ingenuity to that in Hudibras, but it strikes no one as witty like the latter, because there is nothing ludicrous in the image introduced; or if there is, the art of the poet has contrived to mask it under the beauty of his diction. It can scarcely be questioned, however, that, beautiful as the whole description must be felt to be, the simile itself is in bad taste. Nothing can well be more discordant with the emotions which come over the mind as we gaze on a rich sunset passing into sombre twilight than the image of a poor creature gasping in the agonies of death, and nothing more degrading to the magnificent changes of colour in the broad expanse of heaven, and in the eternal hills over which it stretches, than a comparison with the varying hues to be observed on the skin of an expiring fish. The lines in Hudibras might have been penned in prophetic ridicule of the simile of the noble bard.

It does not enter into my design to attempt any analysis of the ludicrous. That quality may exist independently of wit, as wit may exist separately from it. We shall find, in general, that laughter is produced by some unexpected incongruity involving no serious consequences, or some sudden interruption in the habitual train of our ideas; but the feeling is modified and enhanced by a great variety of circumstances, to which I cannot here advert. The possibility of the ludicrous being exhibited in speech without the slightest mixture of wit, is exemplified in those diverting blunders called bulls, and other unconscious trespasses against correctness. We may select as an instance of such laughable absurdities the story told of an Irishman, who, on seeing a stove-grate which, according to the owner, saved half the fuel consumed in an ordinary one, declared that he would immediately have two of the same kind put up in his own house, and thus save the whole. Here is the ludicrous apart from both wit and humour; but if the declaration, instead of being seriously intended, had been made in jest, it would have been humorous.*

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* Childe Harold, Canto IV.

Many of the Facetiæ of Hierocles are of the same character. Amongst other absurdities (if I recollect right), he tells the story of a foolish fellow who, wanting to see how he looked in his sleep, placed himself before a mirror with his eyes shut, and suddenly opening them, tried to catch his image while the lids were still closed. This is absurdity not indeed manifested in language, but in action, and is an instance of that incredible kind of which we owe so many specimens, far surpassing those of Hierocles, to the inventive genius of our transatlantic brethren.

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* "Eadem," says Quinctilian, "quæ si imprudentibus excidant, stulta sunt; si simulamus, venusta creduntur." *De Risu.*

Of a similar character (*i. e.* exhibiting the ludicrous without any admixture of wit) are most instances of bathos, such as the compliment paid by a chemical professor to the celebrated Boyle: "Boyle," he said, "was a great man—a very great man—he was the father of chemistry, and brother to the Earl of Cork."

The next circumstance of importance to be adverted to, as enhancing the effect of wit, is its connection with commendation or censure, exaltation or disparagement. To human beings there seems to be always something interesting and animating *per se* in praise or blame bestowed on their fellow creatures; and the latter, as we shall by and by have to notice, is not the less attractive of the two. Hence, wit in the form of compliment or sarcasm has an additional vivacity and force. Dr. Johnson has remarked that praise is pleasing in proportion to the delicacy of the associations by which it is conveyed. In the case of the party who is praised, this is doubtless owing chiefly to the implied respect and sincerity of him who bestows the compliment. Fulsome adulation—broad, direct, literal flattery,—seems to presuppose a certain degree of assumption in the flatterer, or at least a low opinion of the person who is unfortunate enough to be his idol or his victim. A delicate indirect compliment, on the other hand, is gratifying because it evinces a reluctance to wound that delicacy of feeling in you which it acknowledges, and yet a reluctance not able altogether to resist the admiration which forces itself to the lips. The good opinion seems more sincere from the wish to hide itself; and on the little which is disclosed the imagination of the party complimented is left to erect a structure of its own which, it must be confessed, is seldom wanting in magnificence. But this is not all. The by-stander is also pleased with such a compliment, not only from sympathy but from admiration of the ingenuity displayed. In direct praise there is no ingenuity; in that which is purposely indirect, there must be some, and may be a great deal. When Garrick asked Rich, the manager, what sum Covent Garden Theatre would hold, the latter replied, "I could tell you to a shilling if you would play Richard in it." Here there is praise, and delicacy in the associations by which the praise is conveyed. If the reply had not implied a compliment, it would scarcely have amounted to wit; and if the same compliment had been directly expressed, it would not have been witty at all.

Censure or disparagement has a similar, and even a greater, power of heightening the effect of wit, and is more frequently conjoined with it. Witness the whole tribe of satirists both in prose and in verse. Take an instance from Junius, the prince of sarcastic prose writers. In a letter to the Duke of Grafton, who, as it will be recollected, was descended from one of the mistresses of the second Charles, he thus attacks him:—

"The character of the reputed ancestors of some men has made it possible for their descendants to be vicious in the extreme without being degenerate. Those of your Grace, for instance, left no distressing examples of virtue even to their *legitimate* posterity; and you may look back with pleasure to an illustrious pedigree, in which heraldry has not left a single good quality upon record to insult or upbraid you."

His first letter to Sir William Draper is one of the finest specimens of sarcasm in the English language. I must content myself with citing the opening.

"Your defence of Lord Granby does honour to the goodness of your heart. You feel as you ought to do for the reputation of your friend, and you express yourself in the warmest language of your passions. In any other cause, I doubt not you would have cautiously weighed the consequences of committing your name to the licentious discourses and malignant opinions of the world. But here, I presume, you thought it would be a breach of friendship to lose one moment in consulting your understanding, as if an appeal to the public were no more than a military *coup de main*, where a brave man has no rules to follow but the dictates of his courage. Touched with your generosity, I freely forgive the excesses into which it has led you; and far from resenting those terms of reproach, which, considering that you are an advocate for decorum, you have heaped upon me rather too liberally, I place them to the account of an honest, unreflecting indignation, in which your cooler judgment and natural politeness had no concern. I approve of the spirit with which you have given your name to the public; and if it were a proof of any thing *but* spirit, I should have thought myself bound to follow your example. I should have hoped that even *my* name might carry some authority with it, if I had not seen how very little weight or consideration a printed paper receives, even from the respectable signature of Sir William Draper."

A repartee is recorded of the celebrated Dunning which owes all its effect to the disparagement implied in it. While he was pleading a cause before Lord Mansfield, that accomplished judge exclaimed, "Oh! if that be law, Mr. Dunning, I may burn my law-books." "Better read them, my Lord," was the quick reply.

It is to be remarked, as I have already hinted, that censure seems to enhance the effect of wit in a greater degree, and to be oftener found in conjunction with it, than praise. Censure, by which I here mean all kinds of dispraise, depreciation, and disparagement,—all lowering of what is high and lessening of what is great,—tends to that sort o feeling which in its extreme degree is produced by the ludicrous; and, consequently, not only increases the effect of wit, as praise does, by the interest which it inspires, but by approaching and frequently reaching the laughable, and readily coalescing with it. I fear, too, that it must be confessed, however discreditable it may be to our common nature, that men listen with greater interest to disparagement than to commendation when others are the object. I forget who it is that says of some one, "Valuit nimirum maledicentiâ *gratâ cunctis*, etiam iis qui neque sibi maledici neque maledicere ipsi aliis velint:" and, in reference to the same practice, Quinctilian observes, "libentissime homines audiunt ea, quæ dicere ipsi noluissent."

As a further illustration of this part of my subject, I may introduce to your notice Dean Swift's caustic comment on the motto of William the Third, "Recepit non rapuit," a motto evidently designed to compliment the way in which that king obtained the crown. "A very candid confession," said the Dean, "for all the world knows that the receiver is as bad as the thief."

Another quality which is occasionally found to enhance the effect of wit is the intrinsic beauty, or gaiety, or liveliness, of the ideas combined. There may be great wit in the union of disagreeable images, but, so far as they are disagreeable, they counteract the tendency of wit, which is to please. On the other hand, where images are themselves lively or beautiful, provided the beauty is not of a severe kind, they concur in tendency with the ingenuity displayed in their union, and exalt the pleasure which it affords.

The last circumstance which I have to notice as enhancing the effect of wit is the cumulative force produced by a number of points of analogy not separately striking, but which, when brought to bear on the illustration of the same subject, exhibit so much ingenuity that the whole assumes the character of being witty. My limits will not permit me to quote examples of this, but I may refer you to Addison's celebrated verses to Sir Godfrey Kneller on his picture of George I., as an instance in point.* The impression made on the reader by humorous and satirical writing owes a good deal to this circumstance, and hence, as well as from other causes, it frequently happens that, if you separate a favourite passage from its context for citation, you are disappointed at your auditors not appearing to relish it with the same zest as yourself. It is for this reason that, in adducing illustrations for my present subject, I have selected insulated strokes of wit in which every essential accessary could be included, rather than quotations from dramatists and poets, which, to make them effective, I must have presented of an inconvenient length.

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* These verses are cited by Dugald Stewart, in illustration of the same effect.

The correctness of the principles here laid down may be put to the test by an examination of the principal classes under which strokes of wit may be arranged. We shall perceive that in every instance there is unexpectedness and ingenuity in the combination of ideas, producing surprise and admiration, and that the combination is such as does not carry off the attention from the ingenuity displayed; further, that the effect is greatly enhanced when the ideas themselves are laughable, when they imply praise or blame, and when they are beautiful or animating from other qualities.

1. The first great class of witty combinations comprises those in which the ingenuity consists in employing the same word or phrase in two senses. Puns, indeed, are regarded by many critics as not entitled to the honours of wit; but perhaps a strict examination might show that the emotion produced by them is the same in kind as that which is the effect of the most genuine flashes, although when quite *pure* they certainly can yield none of the pleasure arising from the exhibition of a real analogy or contrast or other substantial relation. They are, however, deservedly held in low estimation, because they are easily produced, and for the most part evince little ingenuity, the majority being mere abortions. Still they are occasionally to be found of a high degree of excellence, as, for example, Canning's pun on the elephant, and Curran's on the judge's wig. One of the most ingenious that

I ever met with ran the round of the journals a few years ago. A young man, who was something of a coxcomb, being at a public dinner, and happening, greatly to his annoyance, to get seated between two plain citizens, leaned over the table and whispered to a friend opposite, "Am I not singularly unfortunate in being flanked by two tailors?" "Why," replied his friend, "they are young beginners, I take it, and can afford to keep only one goose between them."

2. Another class of strokes of wit is constituted by those in which a phrase has not only a double meaning, not only serves to denote two different things, but to indicate an analogy between those things. These are sometimes considered as puns; but if they are to be called puns, they are, at all events, entitled to the praise of genuine wit.

Take as an example the answer of Lord Peterborough to William Penn, in one of Landor's Imaginary Conversations, where they are speaking of the obstacles in the way of enlightening the world. "Children," says the warrior, "are afraid of being left in the dark: men are afraid of *not* being left in it."

Here is unquestionably a play of words, but the play of words is founded on an analogy in the things signified; and if we take Addison's rule that puns cannot be translated into a foreign language, it would not come under that denomination.

Another instance which occurs to me, exhibiting the union of a double meaning in a phrase with an analogy in the ideas expressed, is to be found in a place where perhaps few would think of looking for wit—the "Catechism on the Corn Laws." In answer to the allegation that the landlords are the Corinthian capitals of society, the respondent observes that it is carrying the metaphor too far to say they must be *supported* by the rest. In both these examples there is a union of the requisite qualities of unexpectedness and ingenuity, animated by the lurking satire of the ambiguous expressions.

The following well-known story may be cited as coming under this head. A witness under examination had the question put to him, "On what authority, Sir, do you swear to the mare's age?" "On the best authority," replied the witness. "Then why," rejoined the counsel, "don't you say at once what it is?" "Well," answered the other, "to speak the truth, I had it from the mare's own mouth."

Here the wit arises from two different processes being ingeniously and unexpectedly designated by the same phrase; but the expression is a pun and something more. The processes resemble each other in being modes of ascertaining facts, and this resemblance raises the repartee above a mere verbal witticism.

Previously to passing on to the next division, I may just take notice of a peculiar kind of play on words, which consists in describing circumstances, or changes in words themselves considered merely as words, by expressions that denote at the same time real circumstances or changes in things. A brief and well-known example will at once explain my meaning: "Strip majesty of its externals, and it becomes a jest."

Perhaps the most ingenious piece of this kind of verbal play is an enigma on the letter *h*, often but erroneously attributed to Lord Byron, and the most elegant trifle in its way that I ever happened to meet with. It differs, nevertheless, from the example just cited in this circumstance, that while, in the latter, the sentence is susceptible of a real besides what may be called its verbal application, in the enigma referred to, the expressions, although describing realities, are not susceptible of an application to things, but can be applied only to the words themselves.

This enigma is, in my opinion, full of witty points, and is a good example of the cumulative force, as I have designated it, of strokes of ingenuity bearing on the same theme.

3. A third large class of instances of wit are those which contain a double analogy or double contrast in the ideas; or, in other words, where the objects compared are shown to agree or disagree in two points.

It is remarked by Dryden, that when a poet describes his mistress's bosom to be as white as snow, he is at the utmost merely poetical; but when he proceeds to add "and as cold too," he becomes witty.

By some this twofold relation has been supposed to be the true distinguishing characteristic of wit, and that no combination of ideas or expressions is entitled to rank under the appellation but such as present a double analogy or double contrast. This doctrine, however, would exclude numberless instances which have all the effect of wit, and is consequently inadmissible. It stops short of the true principle. The effect of a double analogy may be resolved into the surprise experienced at what is unexpected, and the admiration felt at what requires ingenuity to produce it. Such analogies are witty, but only in common with other combinations awakening the same emotions. They frequently show more ingenuity than single ones, and are therefore more striking. The remark of Dryden furnishes, perhaps, a sufficient example of the present class, but I will cite one more. A double analogy constitutes the wit of a smart reprimand once given by Coleridge to some of his auditors at Bristol when he was lecturing there. Something he let fall of a democratic tendency was received by a part of the company with loud marks of displeasure, upon which, pausing in his lecture, he exclaimed, "I am not at all surprised that when the red-hot prejudices of aristocrats are suddenly plunged into the cool element of reason they should go off with a hiss."

4. A fourth large class of instances is made up of those in which the point lies in something implied and not expressed, something indirect or covert, often a latent compliment or sly sarcasm; differing in this respect from the last class, where the whole meaning is fully developed. The examples I adduced while pointing out the effects of commendation and disparagement are of this kind.

As another illustration, I may cite a repartee of Lord Chesterfield to the celebrated Miss Chudleigh, afterwards the notorious Duchess of Kingston. It may be necessary to premise that, although still bearing her maiden name, she was at this time actually the wife of Mr. Hervey; but the marriage and the fruits of it were sedulously concealed, and she retained her place as maid of honour to the Queen. Under these circumstances it was no wonder that her reputation suffered; and she one day said to Lord Chesterfield, with the freedom belonging to the manners of that age, "Do you know, my lord, the world says I have had twins?" "Does it!" replied his lordship, who was not in the secret of her marriage; "I make a point of believing only one half of what the world says." Here the wit lies entirely in the implied sarcastic inference or innuendo, which is at once ingenious and unexpected.

5. A fifth class consists of instances in which an expression used by one person is caught up by another, and pushed to some unexpected accepta-

tion or result. An example will explain this best. A lady said to a gentleman, in a tone of remonstrance against what she deemed an ungraceful habit, "You bury your chin in your neck-cloth so!" "Never mind," replied the gentleman, "you are not required to attend the funeral."

Under this head will come an anecdote which appears in the collection of Apophthegms by Lord Bacon already mentioned. "Mr. Popham, afterwards Lord Chief Justice Popham, when he was speaker, and the house of commons had sat long, and done in effect nothing, coming one day to Queen Elizabeth, she said to him, 'Now, Mr. Speaker, what hath passed in the commons' house?' He answered, 'If it please your majesty, seven weeks.'"

In this classification of strokes of wit, I am far from supposing that I have included all possible kinds, although it probably comprises a large proportion of them. The examination which it has enabled us to make serves to confirm the theory which I have ventured to propound. In every case we find that there is something said which is unexpected and ingenious, producing surprise and admiration, and that the effect is often greatly enhanced by the co-operation of other qualities.

If the account which I have given of the nature of wit, and the circumstances which enhance its effects, is correct, it must be seen that no precise line can be drawn between what is witty and what

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it, in fine, like beauty, and many other qualities
arying in degree, which are universally recognised in their decided forms, becomes faint and vague as we descend in the scale, till it is scarcely appreciable, and makes different impressions on different minds, or is wholly overlooked.

Before concluding my survey of the subject I would briefly advert to a question which has been frequently started, viz. whether the faculty of wit is to be improved by cultivation. Undoubtedly it may be to a certain extent. By noticing in what the wit of any expressions consists, dwelling on the peculiar relations in which it deals, and attempting to produce similar combinations, there can be no doubt that ideas and expressions of the desired cast will more frequently and more readily present themselves. Of course, unless the natural faculty is good, the wit, even under the most assiduous cultivation, will not be of a high order: the inferior degrees are within ordinary reach. It is almost a proverbial remark that any person of common abilities may acquire the art of punning. I would, however, advise no one to embark in the enterprise of drilling himself into a man of wit who has any regard for his colloquial reputation or social acceptability. There is no small danger in the attempt to acquire the habit of saying good things. In society few people are less agreeable than those who are perpetually on the watch to strike you with their jests and dazzle you with their brilliant sayings. Wit should flash out in conversation, as a smile breaks over the countenance, occasionally and in turn, with a hundred various expressions of thought and feeling; otherwise it becomes as annoying as an eternal grin or a ceaseless simper. In its nature it is light and dispassionate, and the *continual* attempt to produce it is injurious, if not fatal, to profound thought, close argument, earnest purpose, and warm and elevating sentiment. It was a discreet recommendation of Lord Chesterfield's when he wrote, "Appear to have rather less than more wit than you really have. A wise man will live at least as much within his wit as his income."

In these observations on the colloquial display of this quality it is not of course intended either to proscribe or to disparage what I have been at so much pains to illustrate. The faculty of producing wit and the relish for it, whether in conversation or in writing, are constituent parts of human nature. Like all other faculties and propensities, they are not to be renounced, but to be rightly directed. Wit is an undoubted good within its appropriate limits; and to undervalue or discountenance what is not only a source of exquisite enjoyment, but, when properly wielded, an instrument of indisputable utility, would be folly. The world would be in no little danger of being hemmed in by the solemnities of insincerity, and deluded by the glare of pretension, were these evils left to the comparatively slow and heavy attack of reason, instead of being assailed by the light artillery of wit.

In this respect we cannot fail to recognise it as an important power in society; while in its less warlike character it serves "to point a moral and adorn a tale," to wing many a maxim and irradiate many a truth; and, like its allies fancy and imagination, often indeed in conjunction with them, it is at hand, not merely

> ——— "when sensual pleasures cloy,
> To fill the languid pause with finer joy,"

but to lighten and exhilarate the intervals of respite from strenuous exertion and profound thought.

[The preceding Discourse was written a long time ago, and first read in public in the year 1846. The alterations now made in it, which have been chiefly in the introductory remarks and the illustrative anecdotes, leave the theory just as it was originally propounded. I mention these particulars in consequence of the recent publication of the late Rev. Sydney Smith's most able and interesting Lectures on Moral Philosophy, amongst which there are two devoted to Wit and Humour. Mr. Smith has treated these subjects with his constitutional sound sense and directness of mind, and in his usual pleasant and forcible style. His theory of wit has some strong features of similarity to mine; and it is impossible not to feel gratified by finding myself, through an independent train of speculation, in frequent concurrence with one who was so great a master of both the qualities which he subjects to analysis. The difference between us, as to the theory of wit, seems to lie chiefly in two points: 1. He thinks "that wit is produced by those relations between ideas which excite surprise, and surprise only;" while I consider that, in addition to the feeling of surprise, there must be present a feeling of admiration excited by the ingenuity displayed. Subsequently, indeed, Mr. Smith admits talent or ingenuity to be essential, but only as increasing the surprise; whereas, according to my view, the admiration inspired by the mental adroitness exhibited is a perfectly distinct feeling from the surprise, although simultaneous with it. If the latter were the only emotion concerned, we could scarcely account for the permanent gratification received from genuine strokes of wit long after the novelty has passed away. 2. The other difference, which is of less moment, regards the effect of beauty in the ideas combined.

"The relation," says Mr. Smith, "between ideas which excite surprise in order to be witty must not excite any feeling of the beautiful." On the other hand, I have maintained in the Discourse that the beauty of the ideas introduced, if not of a severe kind, enhances the effect of the wit. After endeavouring to rejudge the question as fairly as I can, I still think that the lighter kinds of beauty assist rather than counteract the lively result; for beauty, it must be recollected, is a term applied to a wide range of pleasing qualities, reaching from the gay to the borders of the sublime; and it is quite in consonance with my theory, that wit should be easily overpowered by that beauty which approaches the solemn and the lofty.

The few words which I have incidentally said on the subject of humour are also at variance with Mr. Smith's doctrine. He appears to make no distinction between the ludicrous and the humorous, regarding, for example, the laughable incident of a gentle slide into the mud, by a corpulent man in a pea-green coat, as full of humour. In my view it is simply ludicrous; but Mr. Smith's *representation* of it is highly humorous, and tallies exactly with my definition of humour as "a combination of ideas or objects *purposely presented to the mind*, which are laughable in themselves, or are made laughable by the mode in which they are presented." The picture drawn by Mr. Smith is a rich illustration of both parts of the definition. The *intentional exhibition* of the ludicrous is, I conceive, essential to humour. The latter is the attribute, not of laughable incidents which may be furnished even by inanimate objects, but of the creations or representations of the artist who brings them before us.

Taking Mr. Smith's theory simply as an account of the ludicrous, a fundamental objection still seems to lie against it. "The ludicrous," he contends, "is incongruity, that excites surprise, and nothing but surprise." "Find," he says, "an incongruity which creates surprise and surprise only, and if it be not ludicrous I am completely wrong."

Admitting this for argument's sake (although he overlooks the circumstance that a degree of incongruity which excites surprise may not be sufficient to provoke laughter), it disposes, I think, of only half the question. All incongruities which create surprise and nothing else may be laughable, but are there not incongruities which are laughable although they have ceased to create surprise?

It appears to me that all incongruities, whether they excite surprise or not, are ludicrous when they reach a certain height, provided, as Mr. Smith's own theory requires, they do not give rise to any other paramount emotion. Doubtless the *first perception* of a ludicrous incongruity is always attended with surprise; but the surprise ceases; while, on the contrary, the incongruity remains as a permanent quality, and still continues to be laughable. It provokes less laughter, it is true; but the circumstance of its losing part of its effect by familiarity is not peculiar to the incongruous or the ludicrous: it is a very common case with beauty, and grandeur, and many other qualities.

If my view of the subject is correct, there is a permanent element in both wit and humour, of which Mr. Smith's theory loses sight. In wit this permanent element is the ingenuity displayed in bringing the combined ideas together; in humour it is the ludicrous character of the combined ideas or objects presented. Surprise is in hoth cases a necessary accompanient at first, because the respective combinations are unexpected; but after the surprise has vanished, the permanent elements remain: the former combination is still ingenious, the latter is still incongruous; the one continues to be witty, and the other to be laughable, or, when purposely presented, humorous.

I am happy to close these comments on Mr. Smith, by borrowing from him one of the most eloquent eulogies on wit ever uttered.

"When wit is combined with sense and information; when it is softened by benevolence, and restrained by strong principle; when it is in the hands of a man who can use it and despise it, who can be witty and something much *better* than witty, who loves honour, justice, decency, good nature, morality, and religion, ten thousand times better than wit; wit is *then* a beautiful and delightful part of our nature. There is no more interesting spectacle than to see the effects of wit upon the different characters of men; than to observe it expanding caution, relaxing dignity, unfreezing coldness,—teaching age, and care, and pain, to smile,—extorting reluctant gleams of pleasure from melancholy, and charming even the pangs of grief. It is pleasant to observe how it penetrates through the coldness and awkwardness of society, gradually bringing men nearer together; and, like the combined force of wine and oil, giving every man a glad heart and a shining countenance. Genuine and innocent wit like this is surely *the flavour of the mind!* Man could direct his ways by plain reason, and support his life by tasteless food; but God has given us wit, and flavour, and brightness, and laughter, and perfumes, to enliven the days of man's pilgrimage, and to 'charm his pained steps over the burning marl.'"—pp. 151, 152.]

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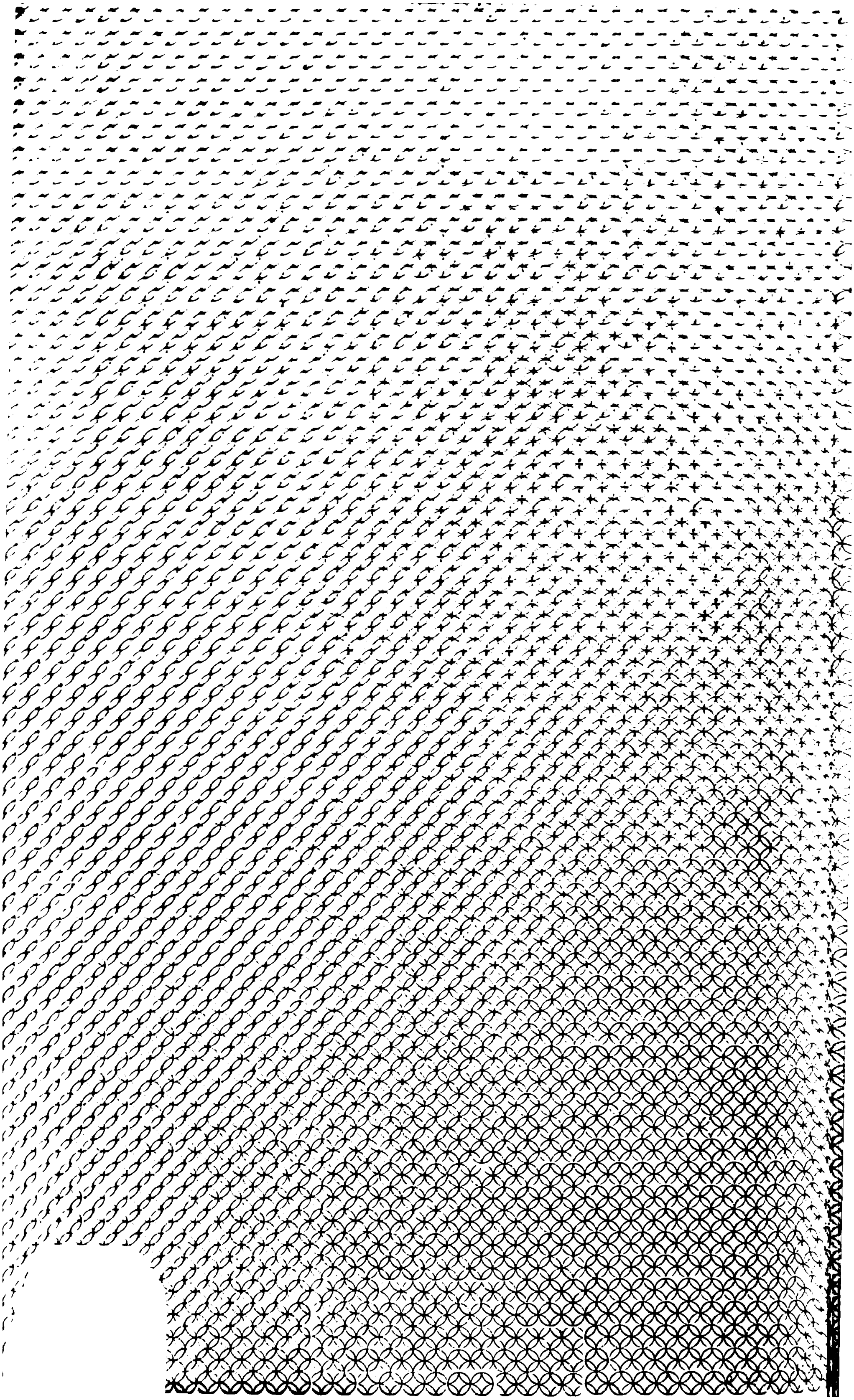

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